EXHIBIT H

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN 3G MOBILE HANDSETS AND COMPONENTS THEREOF**	**Inv. No. 337-TA-613**

NOTICE OF INVESTIGATION

AGENCY: U.S. International Trade Commission

ACTION: Institution of investigation pursuant to 19 U.S.C. § 1337

SUMMARY: Notice is hereby given that a complaint was filed with the U.S. International Trade Commission on August 7, 2007, under section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337, on behalf of InterDigital Communications Corporation of King of Prussia, Pennsylvania and InterDigital Technology Corporation of Wilmington, Delaware. A supplemental letter was filed on August 27, 2007. The complaint alleges violations of section 337 in the importation into the United States, the sale for importation, and the sale within the United States after importation of certain 3G mobile handsets and components thereof by reason of infringement of certain claims of U.S. Patent Nos. 7,117,004 and 7,190,966. The complaint further alleges that an industry in the United States exists as required by subsection (a)(2) of section 337.

The complainant requests that the Commission institute an investigation and, after the investigation, issue a permanent exclusion order and permanent cease and desist orders.

ADDRESSES: The complaint, as supplemented, except for any confidential information contained therein, is available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 500 E Street, S.W., Room 112, Washington, D.C. 20436, telephone 202-205-2000. Hearing impaired individuals are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on 202-205-1810. Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202-205-2000. General information concerning the Commission may also be obtained by accessing its internet server at http://www.usitc.gov. The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at http://www.usitc.gov/secretary/edis.htm

FOR FURTHER INFORMATION CONTACT: David Hollander, Esq., Office of Unfair Import Investigations, U.S. International Trade Commission, telephone (202) 205-2746.

AUTHORITY: The authority for institution of this investigation is contained in section 337 of the Tariff Act of 1930, as amended, and in section 210.10 of the Commission's Rules of Practice and Procedure, 19 C.F.R. § 210.10 (2006).

SCOPE OF INVESTIGATION: Having considered amended complaint, the U.S. International Trade Commission, on September 5, 2007, ORDERED THAT –

(1) Pursuant to subsection (b) of section 337 of the Tariff Act of 1930, as amended, an investigation be instituted to determine whether there is a violation of subsection (a)(1)(B) of section 337 in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain 3G mobile handsets and components thereof by reason of infringement of one or more of claims 1, 2, 7-10, 14, 15, 21, 22, 24, 30-32, 34, 35, 46, 47, 49, 59, and 60 of U.S. Patent No. 7,117,004, and claims 1, 3, and 6-12 of U.S. Patent No. 7,190,966, and whether an industry in the United States exists as required by subsection (a)(2) of section 337;

(2) For the purpose of the investigation so instituted, the following are hereby named as parties upon which this notice of investigation shall be served:

(a) The complainants are –

InterDigital Communications Corporation
781 Third Avenue
King of Prussia, Pennsylvania 19406

InterDigital Technology Corporation
Hagley Building, Suite 105
3411 Silverside Road, Concord Plaza
Wilmington, Delaware 19810

(b) The respondents are the following entities alleged to be in violation of section 337, and are the parties upon which the amended complaint is to be served:

Nokia Corporation
Keilalahdentie 2-4
P.O. Box 226
FIN-00045 Espoo
Finland

Nokia Inc.
6000 Connection Drive
Irving, Texas 75039

(c) The Commission investigative attorney, party to this investigation, is David Hollander, Esq., Office of Unfair Import Investigations, U.S. International Trade Commission, 500 E Street, S.W., Room 401-R, Washington, D.C. 20436; and

(3) For the investigation so instituted, the Honorable Paul J. Luckern is designated as the presiding administrative law judge.

Responses to the complaint and the notice of investigation must be submitted by the named respondents in accordance with section 210.13 of the Commission's Rules of Practice and Procedure, 19 C.F.R. § 210.13. Pursuant to 19 C.F.R. §§ 201.16(d) and 210.13(a), such responses will be considered by the Commission if received not later than 20 days after the date of service by the Commission of the complaint and the notice of investigation. Extensions of time for submitting responses to the complaint and the notice of investigation will not be granted unless good cause therefor is shown.

Failure of a respondent to file a timely response to each allegation in the complaint and in this notice may be deemed to constitute a waiver of the right to appear and contest the allegations of the complaint and this notice, and to authorize the administrative law judge and the Commission, without further notice to the respondent, to find the facts to be as alleged in the complaint and this notice and to enter an initial determination and a final determination containing such findings, and may result in the issuance of a permanent exclusion order or cease and desist order or both directed against a respondent.

By order of the Commission.

Marilyn R. Abbott
Secretary to the Commission

Issued: September 5, 2007

EXHIBIT I

UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.

Before the Honorable Paul J. Luckern
Administrative Law Judge

In the Matter of CERTAIN 3G MOBILE HANDSETS AND COMPONENTS THEREOF	Investigation No. 337-TA-613

AMENDED COMPLAINT OF INTERDIGITAL COMMUNICATIONS, LLC AND INTERDIGITAL TECHNOLOGY CORPORATION UNDER SECTION 337 OF THE TARIFF ACT OF 1930, AS AMENDED

COMPLAINANTS

InterDigital Communications, LLC
781 Third Avenue
King of Prussia, Pennsylvania 19406-1409
(610) 878-7800

InterDigital Technology Corporation
Hagley Building, Suite 105
3411 Silverside Road, Concord Plaza
Wilmington, Delaware 19810-4812
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RESPONDENTS

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Finland
358 (0) 7180 08000

Nokia Inc.
6000 Connection Drive
Irving, Texas 75039
USA
(972) 894-5000

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[1] Appendix C contains Patent Office records related to the last application in the line of applications leading to issuance of the '966 patent. Since the '966 patent is a continuation of the '004 patent, the Patent Office records related to the earlier applications in the line are contained in Appendix A, which is the prosecution history for the '004 patent.

[2] Because the '966 patent is a continuation of the '004 patent, Appendix D only contains copies of each reference that is cited on the face of the '966 patent or mentioned in its prosecution history, but not in the prosecution history of the '004 patent. The references cited in the prosecution history of the '004 patent are included in Appendix B.

I. INTRODUCTION

1. This Amended Complaint is filed by InterDigital Communications, LLC and InterDigital Technology Corporation (collectively referred to as "InterDigital") under Section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337, based on the unlawful importation into the United States, the sale for importation, and the sale within the United States after importation by owners, importers, or consignees of certain 3G mobile handsets and components thereof that infringe any of United States Letters Patent Nos. 7,117,004 ("the '004 patent"), 7,190,966 ("the '966 patent"), and 6,973,579 ("the '579 patent") (sometimes collectively referred to as "the asserted patents").

2. The respondents are: Nokia Corporation and Nokia Inc. (sometimes collectively referred to as "Nokia").

3. Certified copies of the '004 and '966 patents were attached to the original Complaint as Exhibits 1 and 2. A certified copy of the '579 patent is attached to this Amended Complaint as Exhibit 15. InterDigital owns all right, title, and interest in each of the asserted patents. The '004 and the '966 patent share the same recorded assignment, a certified copy of which was attached to the original Complaint as Exhibit 3. A copy of the recorded assignment for the '579 patent is attached to this Amended Complaint as Exhibit 16.

4. An industry as required by 19 U.S.C. § 1337(a)(2) and (3) exists in the United States relating to the technology protected by the asserted patents.

5. InterDigital seeks, as relief, an exclusion order barring from entry into the United States infringing 3G mobile handsets and components thereof imported by or on behalf of the respondents. InterDigital also seeks, as relief, cease-and-desist orders prohibiting the sale for importation, importation, sale after importation, offer for sale, advertising, testing, the

solicitation of sales, and other commercial activity relating to infringing 3G mobile handsets and components thereof.

II. COMPLAINANT

6. Complainant InterDigital Communications, LLC is a Pennsylvania limited liability company with its principal place of business at 781 Third Avenue, King of Prussia, Pennsylvania 19406-1409.[3] InterDigital Technology Corporation is a Delaware corporation with its principal place of business at Hagley Building, Suite 105, 3411 Silverside Road, Concord Plaza, Wilmington, Delaware 19810-4812. InterDigital Communications, LLC and InterDigital Technology Corporation are subsidiaries of InterDigital, Inc., a Pennsylvania corporation.

7. Since 1993, InterDigital has been engaged in the research, development, engineering, and licensing of Code Division Multiple Access ("CDMA") technology in the United States. That work later transitioned into research, development, engineering, and licensing of Wideband CDMA technology ("WCDMA"). WCDMA is one of the wireless technologies often referred to commercially as "3G."

8. At its King of Prussia, Pennsylvania, and Melville, New York, facilities, among other activities, InterDigital researches, develops, engineers, and licenses technology for 3G mobile handsets. InterDigital also files and prosecutes worldwide patent applications covering its innovative research and development of 3G mobile technology and communications protocols used in connection with that technology.

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[3] InterDigital Communications, LLC was previously known as InterDigital Communications Corporation, but in connection with an internal corporate reorganization, effective July 3, 2007, InterDigital Communications Corporation (a Pennsylvania corporation) became InterDigital Communications, LLC (a Pennsylvania limited liability company). When referring to historical events, the term "InterDigital" will include the activities of InterDigital Communications Corporation.

9. InterDigital's research, development, and engineering business has developed proprietary technology that is used in most, if not all, 3G WCDMA handsets made throughout the world. InterDigital's technology has been licensed to significant handset manufacturers throughout the world, including, at times in the past, Nokia.

III. RESPONDENTS

10. Respondent, Nokia Corporation, is a Finnish corporation, with its principal place of business at Keilalahdentie 2-4, P.O. Box 226, FIN-00045 Nokia Group, Finland. Upon information and belief, Nokia Corporation is involved in the design, development and manufacture of 3G mobile handsets through its Mobile Phones Business Group.

11. Respondent, Nokia Inc., is a Delaware corporation, with its principal place of business at 6000 Connection Drive, Irving, Texas 75039. Upon information and belief, Nokia Inc. (d/b/a Nokia Mobile Phones) distributes Nokia-branded handsets in the United States.

IV. THE TECHNOLOGY AND PRODUCTS-AT-ISSUE

12. The technology and products-at-issue concern mobile handsets for use in Third Generation or "3G" systems.

13. The first generation of cellular systems deployed in the United States in the late 1990s was referred to as Advanced Mobile Phone Service, or "AMPS." A variety of entities proposed improvements in that system, leading to "Second Generation" or "2G" systems. Those 2G systems used either Time Division Multiple Access ("TDMA") or Code Division Multiple Access ("CDMA") technology. The drawbacks of these systems spurred further improvements, resulting in so-called "3G" systems that were first deployed in Asia and later in Europe and the United States.

14. The components common to all 3G cellular systems include mobile devices and base stations. A mobile device can be either a portable cellular handset or a cellular PC card

used in laptops. Base stations, which include towers, act as the first point of access for the mobile device into the cellular system. To place a call, for example, a mobile device must first establish communication with a base station over a communication channel.

15. In a 3G cellular CDMA system, many mobile devices share the same frequency channel in the system. This sharing of the frequency channel, while enhancing the efficiency of the system, leads to a gradual degradation of the system performance as the number of mobile devices in the system increases because signals transmitted by each mobile device in the system contribute to the overall interference in the system. It is, therefore, important to minimize the power level at which each mobile device transmits, thereby minimizing the overall interference in the system while at the same time providing an acceptable communication quality to users of mobile devices. Controlling the power transmitted from a mobile device is important, for example, when the device first attempts to establish communication with a base station, such as when a user attempts to place a call using the mobile device.

16. In addition to minimizing the power transmitted by a mobile device as it tries to gain access to a cellular system, it is also important for the device to gain access as quickly as possible. Reducing the access time improves the performance of the system as perceived by users when, for example, they attempt to place calls.

17. While cellular mobile devices have primarily been used in the past to place telephone calls, with the growth of the Internet and multimedia applications, support for high speed data applications, such as web browsing and audio and video streaming, in cellular systems has become increasingly important. To meet the rising demand for high speed data applications, some 3G WCDMA systems now support a technology known as High Speed

Downlink Packet Access ("HSDPA"). HSDPA uses a variety of encoding and other techniques to make high speed data applications feasible in 3G WCDMA systems.

18. InterDigital's continuing development efforts to improve CDMA cellular systems through development of WCDMA and HSDPA technologies have significantly contributed to the evolution of the 3G systems.

19. The specific products-at-issue in this Investigation are mobile handsets, as well as components thereof, that are capable of operating in 3G cellular systems. Some of the accused WCDMA products also implement HSDPA technology. The mobile handsets at issue operate as cellular mobile telephones, allowing users of the handsets to place and receive telephone calls as well as to run data applications, such as web browsing and audio and video streaming.

V. THE ASSERTED PATENTS AND NON-TECHNICAL DESCRIPTION OF THE INVENTIONS

20. There are three asserted patents in this Investigation: U.S. Patent No. 7,117,004 ("the '004 patent"), U.S. Patent No. 7,190,966 ("the '966 patent"), and U.S. Patent No. 6,973,579 ("the '579 patent").

A. U.S. Patent No. 7,117,004

1. Identification of the Patent and Ownership by InterDigital

21. The '004 patent, titled "Method and Subscriber Unit for Performing an Access Procedure," issued on October 3, 2006, to inventors Gary Lomp and Fatih Ozluturk. The '004 patent is based on Patent Application Serial No. 10/866,851 filed on June 14, 2004, and claims priority to an application filed on June 27, 1996.

22. The '004 patent has 18 independent claims and 48 dependent claims. Claims 1, 2, 7-10, 14, 15, 21, 22, 24, 30-32, 34, 35, 46, 47, 49, 59, and 60 are being asserted in this Investigation.

23. InterDigital Technology Corporation owns by assignment the entire right, title, and interest in and to the '004 patent. *See* Exhibit 3 attached to the original Complaint.

24. A certified copy and three copies of the prosecution history of the '004 patent and four copies of each reference cited on the face of the '004 patent or mentioned in its prosecution history were attached to the original Complaint as Appendices A and B.

2. Non-Technical Description of the Patent

25. The '004 patent generally covers improvements to the way a mobile device gains access to a cellular CDMA system. In a CDMA system, the signals transmitted by mobile devices contribute to the overall interference in the system. To minimize interference, it is particularly important that mobile devices transmit at the minimum possible power level necessary to gain access to the system. It is also important for mobile devices to gain access to the system as quickly as possible when, for example, users attempt to place calls.

26. The improvements of the '004 patent achieve the above and other objectives. When a mobile device attempts to gain access to a cellular CDMA system, the mobile device starts transmitting short probe signals at an initial low power and gradually increases its transmission power until a base station in the system detects one of the short probe signals transmitted by the mobile device. In this fashion, the mobile device "ramps up" its transmission power until the base station hears the mobile device. Transmitting short probe signals while ramping up the power of the signals during the initial attempt to access the system enables the mobile device to gain access to the system in an efficient and rapid manner with minimal contribution to interference in the system.

27. In contrast to the power ramp up improvements of the '004 patent, prior known approaches employed a series of long signals, which included a message intended to be communicated along with a header. By repeatedly transmitting the entire long message and

header, the initial power ramp up procedure introduced substantial unwanted interference into the system, and it took longer for mobile devices to gain access to the system. The additional interference caused poor system performance, including poor connections and failed call attempts. The prior approaches also resulted in longer delays for mobile devices to gain access to the system, further degrading system performance.

3. Foreign Counterparts to the Patent

28. The '004 patent and its related U.S. applications have a number of foreign counterparts. Those foreign patents and applications, as well as related U.S. applications and patents, are identified in Exhibit 4 attached to the original Complaint.

4. Licenses

29. Under Commission Rule 210.12(a)(9)(iii), a list of licensed entities was attached to the original Complaint as Confidential Exhibit 5. Under Commission Rule 210.12(c)(1), three copies of the licenses were submitted with the original Complaint as Confidential Appendix E. By a supplement to the original Complaint submitted on August 27, 2007, Confidential Exhibit 5 was revised, and Confidential Appendix E was supplemented with additional documents. A further revised version of Confidential Exhibit 5 that identifies an additional licensee is attached to this Amended Complaint and confidential Appendix E is being further supplemented with additional documents related to the additional license identified in Confidential Exhibit 5.

B. U.S. Patent No. 7,190,966

1. Identification of the Patent and Ownership by InterDigital

30. The '966 patent, titled "Method and Apparatus for Performing an Access Procedure," issued on March 13, 2007, to inventors Gary Lomp and Fatih Ozluturk. The '966 patent is based on Patent Application Serial No. 11/169,490 filed on June 29, 2005, and claims priority to the same June 27, 1996 application, to which the asserted '004 patent also claims

priority. The '996 patent resulted from a continuation of the application that led to the asserted '004 patent.

31. The '966 patent has 1 independent claim and 11 dependent claims. Claims 1, 3, and 6-12 are being asserted in this Investigation.

32. InterDigital Technology Corporation owns by assignment the entire right, title, and interest in and to the '966 patent. *See* Exhibit 3 attached to the original Complaint.

33. The original Complaint was accompanied by a certified copy and three copies of the portion of the prosecution history of the '966 patent that was not included in Appendix A (the prosecution of the '004 patent) and four copies of each reference that was cited on the face of the '966 patent or mentioned in its prosecution history but not already included in Appendix B. *See* Appendices C and D attached to the original Complaint.

2. Non-Technical Description of the Patent

34. The '966 patent generally covers improvements to the way a mobile device gains access to a cellular CDMA system. In a CDMA system, the signals transmitted by mobile devices contribute to the overall interference in the system. To minimize interference, it is particularly important that mobile devices transmit at the minimum possible power level necessary to gain access to the system. It is also important for mobile devices to gain access to the system as quickly as possible when, for example, users attempt to place calls.

35. The improvements of the '966 patent achieve the above and other objectives. When a mobile device attempts to gain access to a cellular CDMA system, the mobile device starts transmitting short signals at an initial low power and gradually increases its transmission power until a base station in the system detects one of the short signals transmitted by the mobile device. After the base station hears the mobile device, the mobile device then transmits to the base station a message that is longer in duration than each of the successively transmitted short

signals, indicating to the base station that the mobile device wants to establish communication with the base station. In this fashion, the mobile device "ramps up" its transmission power until the base station hears the mobile device. Transmitting short signals while ramping up the power of the signals during the initial attempt to access the system enables the mobile device to gain access to the system in an efficient and rapid manner with minimal contribution to interference in the system.

36. In contrast to the power ramp up improvements of the '966 patent, prior known approaches employed a series of long signals, which included a message intended to be communicated along with a header. By repeatedly transmitting the entire long message and header, the initial power ramp up procedure introduced substantial unwanted interference into the system, and it took longer for mobile devices to gain access to the system. The additional interference caused poor system performance, including poor connections and failed call attempts. The prior approaches also resulted in longer delays for mobile devices to gain access to the system, further degrading system performance.

3. Foreign Counterparts to the Patent

37. The '966 patent and its related U.S. applications have a number of foreign counterparts. Those foreign patents and applications, as well as related U.S. applications and patents, are the same as those identified in connection with the related '004 patent, and are identified in Exhibit 4 attached to the original Complaint.

4. Licenses

38. Pursuant to Commission Rule 210.12(a)(9)(iii), a list of licensed entities was attached to the original Complaint as Confidential Exhibit 5, and was revised by the supplement to the original Complaint on August 27, 2007. Pursuant to Commission Rule 210.12(c)(1), three copies of the licenses were submitted with the original Complaint as Confidential Appendix E,

which was supplemented on August 27, 2007, with three copies of additional documents identified in the August 27, 2007 supplement to the original Complaint. A further revised version of Confidential Exhibit 5 that identifies an additional licensee is attached to this Amended Complaint and confidential Appendix E is being further supplemented with additional documents related to the additional license identified in Confidential Exhibit 5.

C. U.S. Patent No. 6,973,579

1. Identification of the Patent and Ownership by InterDigital

39. The '579 patent, titled "Generation of User Equipment Identification Specific Scrambling Code for the High Speed Shared Control Channel," issued on December 6, 2005, to inventors Stephen G. Dick, Nader Bolourchi, and Sung-Hyuk Shin. The '579 patent is based on Patent Application Serial No. 10/187,640, filed on July 1, 2002, and claims priority to two provision applications filed on May 7 and May 13, 2002, respectively.

40. The '579 patent has 5 independent claims and 5 dependent claims. Claims 1, 2, 3, and 4 are being asserted in this investigation.

41. InterDigital Technology owns by assignment the entire right, title, and interest in and to the '579 patent. *See* Exhibit 16, which is submitted with this Amended Complaint.

42. This Amended Complaint is accompanied by a certified copy and three copies of the prosecution history of the '579 patent and four copies of each reference cited on the face of the '579 patent or mentioned in its prosecution history. *See* Appendices G and H.

2. Non-Technical Description of the Patent

43. The '579 patent generally concerns an improved apparatus for a CDMA system with HSDPA capability. HSDPA capability makes possible high data rate communication, such as video streaming from the base station to the mobile device. The improvement of the '579 patent relates to a high speed control channel that is shared by multiple mobile devices in the

system. The system uses this shared high speed control channel to transmit important control information to mobile devices, each of which is identified by a unique user equipment ("UE") identifier in the system. The '579 patent covers the manner in which a mobile device generates a scrambling code using the UE identifier. The mobile device uses the scrambling code to identify, on the shared high speed control channel, control information directed to the mobile device.

44. During the standardization process for HSDPA, changes were made in the length of the UE identifier. Specifically, the HSDPA standard changed the length of the UE identifier from 10 bits to 16 bits. As a result of this change, a need arose for a way to generate a scrambling code using the 16 bit UE identifier that would be consistent with other requirements of the standard.

45. The applicable standards-setting organization solicited from participants, including InterDigital, Siemens, and others, proposed technical solutions that would enable scrambling of the high speed shared channel, carrying control information for multiple users, with the 16 bit UE identifier. InterDigital participated in the standardization process and proposed a solution to this technical problem.

46. InterDigital's solution, which is disclosed in the '579 patent, involves the use of a half-rate convolutional encoder to generate a scrambling code for the high speed shared control channel from the UE identifier. This solution advantageously reduces false detection of control information over the high speed shared control channel by mobile devices other than the intended mobile device.

47. After reviewing the various proposals and evaluating the technical merits of each, InterDigital's proposed solution was adopted by the standards-setting organization.

3. Foreign Counterparts to the Patent

48. The '579 patent and its related U.S. applications have a number of foreign counterparts. Those foreign patents and applications, as well as related U.S. applications and patents, are identified in Exhibit 17.

4. Licenses

49. Pursuant to Commission Rule 210.12(a)(9)(iii), a list of licensed entities is attached to this amended complaint as Supplemental Revised Confidential Exhibit 5. Pursuant to Commission Rule 210.12(c)(1), three copies of the licenses have been or are being submitted with this amended complaint as Confidential Appendix E.

VI. UNLAWFUL AND UNFAIR ACTS OF RESPONDENTS— PATENT INFRINGEMENT

50. The accused products are cellular telephone handsets capable of operating within a 3G system. Certain accused products are also capable of using HSDPA technology.

51. Generally, any of respondents' handsets capable of operating in a 3G WCDMA system are accused of infringing claims 1, 2, 7-10, 14, 15, 21, 22, 24, 30-32, 34, 35, 46, 47, 49, 59, and 60 of the '004 patent, and claims 1, 3, and 6-12 of the '966 patent.

52. Additionally, any of respondents' handsets capable of operating pursuant to the HSDPA standard are further accused of infringing claims 1-4 of the '579 patent.

53. In order to confirm that the accused products operate in the manner covered by the asserted patents, InterDigital has tested a selected accused product using analytical techniques that are generally accepted in the industry. The results of those analyses support the infringement allegations set forth in the claim charts accompanying the original Complaint.

54. On information and belief, some of the accused products support HSDPA features set forth in relevant 3G standards, and operate in the manner covered by the '579 patent. A

claim chart accompanying this Amended Complaint sets forth the analysis of infringement by one of the accused products of the '579 patent, based on information and belief and the relevant 3G standards.

55. On information and belief, the respondents collectively manufacture, import, and sell in the United States after importation 3G mobile handsets that infringe one or more of the asserted patents. On information and belief, certain Nokia handsets can operate in a 3G WCDMA system, and some can also use HSDPA techniques. For example, at least the Nokia N75 and N95 (also known as the N95-3 in the United States) handsets infringe one or more of the asserted patents. The identification of specific models is not intended to limit the scope of the Investigation, and any remedy should extend to all infringing models.

56. A chart that applies representative claim 1 of the '004 patent to the accused Nokia N75 handset was attached to the original Complaint as Exhibit 6.

57. A chart that applies representative claim 1 of the '966 patent to the accused Nokia N75 handset was attached to the original Complaint as Exhibit 7.

58. A chart that applies representative claim 1 of the '579 patent to the accused Nokia N95 handset is attached to this Amended Complaint as Exhibit 18.

59. To the extent any of the asserted claims require products sold by the respondents to be operated in a 3G WCDMA/HSDPA system in order to satisfy all claim elements, on information and belief, the accused products infringe both directly and indirectly.

60. On information and belief, the respondents test or operate the accused products in the United States by using them in a 3G WCDMA/HSDPA system and performing the claimed methods, thereby directly infringing any claim requiring such operation.

61. Respondents have had notice of the asserted patents since before the filing of the original Complaint or, at a minimum, had notice of the '004 and '966 patents upon the filing of the original Complaint and will receive notice of the '579 patent upon the filing of this amended complaint.

62. The accused products listed above are specifically designed to be used in a 3G WCDMA system. Moreover, some products designed to be used in a 3G WCDMA system are also configured to comply with the HSDPA standards. When the accused products are operated in a WCDMA/HSDPA system, they have no substantial non-infringing use.

63. Respondents induce infringement of the asserted claims by advertising their products as complying with the 3G WCDMA and HSDPA standards and being capable of operating according to those standards, by publishing manuals and promotional literature describing the operation of the accused devices in an infringing manner according to the 3G WCDMA and HSDPA standards, and by offering support and technical assistance to their customers that encourage use of the accused products in ways that infringe the asserted claims.

VII. SPECIFIC INSTANCES OF UNFAIR IMPORTATION AND SALE

64. On or around May 4, 2007, representatives for InterDigital purchased several imported Nokia handsets in the United States. Exhibit 13 is a copy of a receipt for the purchase of a Nokia N75 handset, and a series of photographs of the handset and the box in which the handset was delivered. The label on the box bears a Nokia logo. The label on the inside of the handset states that the handset was made in Finland. A physical sample of the Nokia N75 handset (that was purchased as described above) was submitted with the original Complaint as Appendix F.

65. On September 27, 2007, representatives for InterDigital purchased several imported Nokia N95 handsets in the United States. Exhibit 20 is a copy of a receipt for the purchase of a

Nokia N95 handset, and a series of photographs of the handset and the box in which the handset was packaged. The label on the box bears a Nokia logo. The label on the inside of the handset states that the handset was made in Finland. A physical sample of the Nokia N95 handset (that was purchased as described above) is submitted with this Amended Complaint as Appendix I.

VIII. HARMONIZED TARIFF SCHEDULE ITEM NUMBERS

66. On information and belief, the Harmonized Tariff Schedule of the United States item numbers under which the infringing Nokia handsets or components thereof may be imported into the United States may be at least HTSUS 8525 and subsections thereof (including 8525.20.05, 8525.20.30, and 8525.20.90), 8527.90.40, 8527.90.95, and 8529 and subsections thereof.

IX. RELATED LITIGATION

67. There has been no court or agency litigation, domestic or foreign, involving the specific unfair acts asserted in this Complaint.

68. Nokia filed a suit in 2005 against InterDigital Communications Corporation and InterDigital Technology Corporation in the U.S. District Court for the District of Delaware seeking a declaratory judgment that a number of InterDigital patents relating to cellular telephone technology were invalid or not infringed. None of the asserted patents was the subject of any declaratory judgment request, and that declaratory judgment claim was dismissed by the Court. The complaint also claimed that certain of InterDigital's statements that certain of InterDigital's patents are essential to the 3G standard violated the Lanham Act. *See Nokia Corp. v. InterDigital Communications Corp.*, Civ. Action No. 05-16 (D. Del. 2005). Nokia later identified specific InterDigital patents, including the '579 patent but not the '004 or '966 patents, and alleges such patents are not essential to the 3G standard. Pursuant to a First Amended Case Management Order issued on July 9, 2007, by the Special Master in that case and adopted by the

Court on August 29, 2007, Nokia's attempt to take discovery on validity, infringement, and enforceability was denied, but Nokia may seek to modify this limitation after claim construction. Moreover, on August 20, 2007, the Special Master ordered Nokia to provide its contentions concerning the essentiality of the '004 and '966 patents. Nokia objected to the August 20, 2007 order, but its objection was overruled by the Court. Nokia has not yet provided its contentions.

69. In 2003, a dispute arose between InterDigital and Nokia concerning Nokia's royalty obligations under a Patent License Agreement. This matter was submitted to arbitration, and in mid-2005 the Arbitral Tribunal issued its award finding, among other things, that Nokia's obligation to pay certain royalties had been triggered. There was a subsequent action in the Southern District of New York confirming the Award and also a subsequent arbitration between the parties. In April 2006, the parties settled these disputes in a manner that provided Nokia with a 2G license for certain products and a release for certain 3G-related activities occurring before the effective date of the settlement. There is no ongoing 3G license between InterDigital and Nokia.

70. On March 23, 2007, InterDigital filed a complaint with the International Trade Commission identifying as proposed respondents Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., and Samsung Telecommunications America LLC, and alleging infringement of the '004 patent, U.S. Patent No. 6,674,791 ("the '791 patent"), and the '579 patent. The complaint requested that the Commission institute an investigation and, after determining there had been a violation of 19 U.S.C. § 1337, issue a permanent exclusion order and a permanent cease-and-desist order. An investigation was instituted on April 20, 2007, as Investigation No. 337-TA-601. On June 4, 2007, InterDigital filed an amended complaint in that

investigation alleging infringement of the '966 patent. That investigation is currently in discovery.

71. On March 23, 2007, the same day InterDigital filed the complaint in Investigation No. 337-TA-601, InterDigital filed a complaint against the same Samsung entities in the U.S. District Court for the District of Delaware alleging infringement of the '004, '791, and '579 patents. *See InterDigital Communications Corp. v. Samsung Electronics Corp., Ltd.*, Civ. Action No. 07-165 (D. Del. 2007). On May 4, 2007, InterDigital filed an amended complaint in that action alleging infringement of the '966 patent. This action in the District of Delaware has been stayed until the ITC determination in Investigation No. 337-TA-601 becomes final.

72. On March 23, 2007, the same day InterDigital filed the complaints in Investigation No. 337-TA-601 and in the U.S. District Court for the District of Delaware, Samsung Telecommunications America LLP ("Samsung Telecom") and Samsung Electronics Co., Ltd. ("Samsung Electronics") filed a complaint against defendants InterDigital Communications Corporation, InterDigital Technology Corporation, and Tantivy Communications, Inc. in the U.S. District Court for the District of Delaware. The complaint seeks damages and injunctive relief for defendants' alleged refusal to comply with their contractual obligations to be prepared to license their patents on fair, reasonable, and nondiscriminatory ("FRAND") terms. The complaint also seeks declarations that (i) InterDigital's alleged refusal to provide FRAND licenses to Samsung Telecom or Samsung Electronics constitutes an unfair business practice; (ii) Samsung Telecom and Samsung Electronics have a right to InterDigital's patents by virtue of their relationship with Qualcomm Incorporated; (iii) the claims of various InterDigital's patents are unenforceable; (iv) the claims of various InterDigital's patents are invalid; and (v) the claims of various InterDigital's patents are not infringed by Samsung Telecom or Samsung Electronics.

See Samsung Electronics Corp., Ltd. v. InterDigital Communications Corp., Civ. Action No. 07-167 (D. Del. 2007). None of the asserted patents was specifically identified in the complaint. This action has been stayed until September 14, 2007.

73. On August 7, 2007, the same day InterDigital filed the complaint in this investigation, InterDigital filed a complaint against the same Nokia entities in the U.S. District Court for the District of Delaware alleging infringement of the '004 and '966 patents. *See InterDigital Communications, LLC v. Nokia Corp.*, Civ. Action No. 07-489 (D. Del. 2007). On September 28, 2007, the same day that motion for leave to file this amended complaint was filed, InterDigital filed an amended complaint in that action to allege infringement of the '579 patent. Nokia has not yet filed an answer to the complaint or amended complaint in that action.

X. THE DOMESTIC INDUSTRY

74. InterDigital has established a domestic industry under at least 19 U.S.C. § 1337(a)(3)(C).

75. A domestic industry exists with respect to InterDigital's activities in the United States that exploit the asserted patents by reason of InterDigital's substantial investment in domestic research, development, engineering, and licensing of the WCDMA and HSDPA technology protected by the patents, including past and present development of the technology itself, testing of that technology and components, and technical support services to licensees. InterDigital's research activities with respect to CDMA technology date back to 1993 and continue today.

A. Investments in Research and Development, and Engineering

76. InterDigital operates facilities in King of Prussia, Pennsylvania, and Melville, New York, that are used for the research and development and engineering of technology used in the 3G mobile handsets at issue and covered by the asserted patents.

77. In 1993, InterDigital began working on research and development of a CDMA technology at its Melville, New York facility. That work later transitioned into research and development of WCDMA technology. That WCDMA technology is utilized by handsets and PC cards today, including in the accused products, and is covered by the '004 and '966 patents. In 1997, InterDigital also began working on CDMA research and development projects at its King of Prussia location. Between 1993 and 1999, InterDigital employed between 21 and 130 engineering and technical staff, associated support personnel, and management personnel in that research.

78. From approximately 2000 to the present, InterDigital has been working at its Melville and King of Prussia locations on research and development projects that eventually resulted in HSDPA technology. HSDPA technology is covered by the '579 patent and is used by the accused handsets. InterDigital's HSDPA research and development work is directed at products and methods that use both the WCDMA technology and the HSDPA technology, and continues to this day. As a result, those accused HSDPA products use the technology in the '579 patent, as well as technologies covered by the '004 and '966 patents. From approximately 2000 to the present, InterDigital has employed between 12 and 162 engineering and technical staff, associated support personnel, and management personnel in the HSDPA research.

79. The value of InterDigital's plant and equipment and the specific number of employees involved in these research and development activities are disclosed in more detail in Confidential Exhibit 14, a revised version of which is attached to this Amended Complaint.

B. Investments in Licensing

80. InterDigital has invested in personnel and resources to monitor the market, identify potential manufacturers and users of its 3G wireless technology, establish contacts with those

potential manufacturers and users, provide pre-licensing technical services, negotiate licenses, conduct technology transfers, and monitor licensee compliance with the licensing program.

81. InterDigital's 3G wireless technology licensing efforts include the '004, '966, and '579 patents.

82. InterDigital's investments in intellectual property and technology licensing operations attributable to domestic industry activities exploiting the '004, '966, and '579 patents are set forth in more detail in the revised Confidential Exhibit 14 attached to this Amended Complaint.

XI. RELIEF REQUESTED

83. WHEREFORE, by reason of the foregoing, Complainant InterDigital respectfully requests that the United States International Trade Commission:

(a) Institute an immediate Investigation pursuant to Section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337(a)(1)(B)(i) and (b)(1) with respect to violations of Section 337 based upon the importation, sale for importation, and sale after importation into the United States of infringing 3G mobile handsets and components thereof that infringe one or more of the asserted claims of InterDigital's United States Letters Patent Nos. 7,117,004, 7,190,966, or 6,973,579;

(b) Schedule and conduct a hearing on said unlawful acts and, following said hearing;

(c) Issue a permanent exclusion order pursuant to 19 U.S.C. § 1337(d)(1) barring from entry into the United States all infringing 3G mobile handsets and components thereof imported by or on behalf of any of the respondents;

(d) Issue a permanent cease-and-desist order, pursuant to 19 U.S.C. § 1337(f), directing each respondent to cease and desist from importing, marketing, advertising, demonstrating, warehousing inventory for distribution, offering for sale, selling, distributing,

licensing, or using 3G mobile handsets or components thereof that infringe one or more claims of the asserted patents; and

(e) Grant such other and further relief as the Commission deems just and proper based on the facts determined by the Investigation and the authority of the Commission.

Respectfully Submitted,

Dated: DRAFT

Smith R. Brittingham IV
Patrick J. Coyne
Christopher P. Isaac
Lionel M. Lavenue
Houtan K. Esfahani
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Counsel for Complainants
InterDigital Communications, LLC and
InterDigital Technology Corporation

VERIFICATION OF AMENDED COMPLAINT

I, Bruce G. Bernstein, declare, in accordance with 19 C.F.R. §§ 210.4 and 210.12(a), under penalty of perjury, that the following statements are true:

1. I am the Chief Intellectual Property and Licensing Officer for Complainant InterDigital Communications, LLC, as well as for Complainant InterDigital Technology Corporation. I am duly authorized to sign this Amended Complaint on behalf of both Complainants.

2. I have read the foregoing Amended Complaint.

3. To the best of my knowledge, information, and belief, based on reasonable inquiry, the foregoing Amended Complaint is well-founded in fact and is warranted by existing law or by a non-frivolous argument for the extension, modification, or reversal of existing law or the establishment of new law.

4. The allegations and other factual contentions have evidentiary support or are likely to have evidentiary support after a reasonable opportunity for further investigation or discovery.

5. The foregoing Amended Complaint is not being filed for an improper purpose, such as to harass or to cause unnecessary delay or needless increase in the cost of litigation.

Executed on: October ____, 2007

____
Bruce G. Bernstein
Chief Intellectual Property and Licensing Officer
InterDigital Communications, LLC

Executed on: October ____, 2007

____
Bruce G. Bernstein
General Patent Counsel
InterDigital Technology Corporation

EXHIBIT 18

EXHIBIT 18
INFRINGEMENT OF U.S. PATENT NO. 6,973,579 - NOKIA N95

CLAIM 1	**INTERDIGITAL'S INFRINGEMENT PROOFS** **Web Page from Nokia's Website (Exhibit 21)** **TS 125.212, Version 5.10.0, Release 5 (Exhibit 19)**
1. An apparatus comprising:	Nokia advertises on its website that the Nokia N95-3 handset (also known as the N95 handset) uses 3G wireless technology, including High Speed Downlink Packet Access (HSDPA). *See, e.g.*, Exhibit 21. Industry standard for 3G wireless technology specifies requirements that devices providing HSDPA capability must meet. *See, e.g.*, Exhibit 19.
an input configured to accept a user identification comprising L bits; and	As required by industry standard for HSDPA capable devices, the N95 includes an input for processing a 16-bit (L bits) User Equipment (UE) identity. *See, e.g.*, Exhibit 19, § 4.6.7.
a 1/2 rate convolutional encoder for processing at least the bits of the user identification by a 1/2 rate convolutional code to produce a code used for scrambling a high speed shared control channel (HS-SCCH).	As required by industry standard for HSDPA capable devices, the N95 includes a ½ rate convolutional encoder for "encoding the UE identity bits using the rate ½ convolutional coding" to generate an intermediate code word. *See, e.g.*, Exhibit 19, § 4.6.7. As further required by industry standard, the N95 uses the intermediate code word to generate a 40-bit UE specific scrambling sequence, which is used for scrambling a shared control channel (HS-SCCH) associated with a high speed downlink shared channel (HS-DSCH). *See, e.g.*, Exhibit 19, §§ 3.3 & 4.6.7.

EXHIBIT 19

ETSI TS 125 212 V5.10.0 (2005-06)

Technical Specification

Universal Mobile Telecommunications System (UMTS); Multiplexing and channel coding (FDD) (3GPP TS 25.212 version 5.10.0 Release 5)

Reference
RTS/TSGR-0125212v5a0

Keywords
UMTS

ETSI

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Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp .

Contents

Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document describes the characteristics of the Layer 1 multiplexing and channel coding in the FDD mode of UTRA.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TS 25.201: "Physical layer - General Description".

[2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[3] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[4] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[5] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[6] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[7] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[8] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[9] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[10] 3GPP TS 25.225: "Physical layer – Measurements (TDD)".

[11] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[12] 3GPP TS 25.402: "Synchronisation in UTRAN, Stage 2".

[13] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol Specification".

[14] ITU-T Recommendation X.691 (12/97) "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

TG: Transmission Gap is consecutive empty slots that have been obtained with a transmission time reduction method. The transmission gap can be contained in one or two consecutive radio frames.

TGL: Transmission Gap Length is the number of consecutive empty slots that have been obtained with a transmission time reduction method. $0 \leq TGL \leq 14$. The CFNs of the radio frames containing the first empty slot of the transmission

gaps, the CFNs of the radio frames containing the last empty slot, the respective positions N_{first} and N_{last} within these frames of the first and last empty slots of the transmission gaps, and the transmission gap lengths can be calculated with the compressed mode parameters described in [5].

TrCH number: The transport channel number identifies a TrCH in the context of L1. The L3 transport channel identity (TrCH ID) maps onto the L1 transport channel number. The mapping between the transport channel number and the TrCH ID is as follows: TrCH 1 corresponds to the TrCH with the lowest TrCH ID, TrCH 2 corresponds to the TrCH with the next lowest TrCH ID and so on.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

$\lceil x \rceil$	round towards ∞, i.e. integer such that $x \le \lceil x \rceil < x+1$
$\lfloor x \rfloor$	round towards -∞, i.e. integer such that $x-1 < \lfloor x \rfloor \le x$
$\lvert x \rvert$	absolute value of x
sgn(x)	signum function, i.e. $\mathrm{sgn}(x) = \begin{cases} 1; & x \ge 0 \\ -1; & x < 0 \end{cases}$
N_{first}	The first slot in the *TG*, located in the first compressed radio frame if the TG spans two frames.
N_{last}	The last slot in the *TG*, located in the second compressed radio frame if the TG spans two frames.
N_{tr}	Number of transmitted slots in a radio frame.

Unless otherwise is explicitly stated when the symbol is used, the meaning of the following symbols is:

i	TrCH number
j	TFC number
k	Bit number
l	TF number
m	Transport block number
n_i	Radio frame number of TrCH i.
p	PhCH number
r	Code block number
I	Number of TrCHs in a CCTrCH.
C_i	Number of code blocks in one TTI of TrCH i.
F_i	Number of radio frames in one TTI of TrCH i.
M_i	Number of transport blocks in one TTI of TrCH i.
$N_{data,j}$	Number of data bits that are available for the CCTrCH in a radio frame with TFC j.
$N^{cm}_{data,j}$	Number of data bits that are available for the CCTrCH in a compressed radio frame with TFC j.
P	Number of PhCHs used for one CCTrCH.
PL	Puncturing Limit for the uplink. Signalled from higher layers
RM_i	Rate Matching attribute for TrCH i. Signalled from higher layers.

Temporary variables, i.e. variables used in several (sub)clauses with different meaning.

x, X
y, Y
z, Z

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ARQ	Automatic Repeat Request
BCH	Broadcast Channel
BER	Bit Error Rate
BLER	Block Error Rate
BS	Base Station
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel

CFN	Connection Frame Number
CRC	Cyclic Redundancy Check
DCH	Dedicated Channel
DL	Downlink (Forward link)
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DS-CDMA	Direct-Sequence Code Division Multiple Access
DTX	Discontinuous Transmission
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FER	Frame Error Rate
GF	Galois Field
HARQ	Hybrid Automatic Repeat reQuest
HS-DPCCH	Dedicated Physical Control Channel (uplink) for HS-DSCH
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	Shared Control Channel for HS-DSCH
MAC	Medium Access Control
Mcps	Mega Chip Per Second
MS	Mobile Station
OVSF	Orthogonal Variable Spreading Factor (codes)
PCCC	Parallel Concatenated Convolutional Code
PCH	Paging Channel
PhCH	Physical Channel
PRACH	Physical Random Access Channel
RACH	Random Access Channel
RSC	Recursive Systematic Convolutional Coder
RV	Redundancy Version
RX	Receive
SCH	Synchronisation Channel
SF	Spreading Factor
SFN	System Frame Number
SIR	Signal-to-Interference Ratio
SNR	Signal to Noise Ratio
TF	Transport Format
TFC	Transport Format Combination
TFCI	Transport Format Combination Indicator
TPC	Transmit Power Control
TrCH	Transport Channel
TTI	Transmission Time Interval
TX	Transmit
UL	Uplink (Reverse link)

4 Multiplexing, channel coding and interleaving

4.1 General

Data stream from/to MAC and higher layers (Transport block / Transport block set) is encoded/decoded to offer transport services over the radio transmission link. Channel coding scheme is a combination of error detection, error correcting, rate matching, interleaving and transport channels mapping onto/splitting from physical channels.

4.2 General coding/multiplexing of TrCHs

This section only applies to the transport channels: DCH, RACH, BCH, FACH and PCH. Other transport channels which do not use the general method are described separately below.

Data arrives to the coding/multiplexing unit in form of transport block sets once every transmission time interval. The transmission time interval is transport-channel specific from the set {10 ms; 20 ms, 40 ms, 80 ms}, where 80 ms TTI for DCH shall not be used unless SF=512.

The following coding/multiplexing steps can be identified:

- add CRC to each transport block (see subclause 4.2.1);
- transport block concatenation and code block segmentation (see subclause 4.2.2);
- channel coding (see subclause 4.2.3);
- radio frame equalisation (see subclause 4.2.4);
- rate matching (see subclause 4.2.7);
- insertion of discontinuous transmission (DTX) indication bits (see subclause 4.2.9);
- interleaving (two steps, see subclauses 4.2.5 and 4.2.11);
- radio frame segmentation (see subclause 4.2.6);
- multiplexing of transport channels (see subclause 4.2.8);
- physical channel segmentation (see subclause 4.2.10);
- mapping to physical channels (see subclause 4.2.12).

The coding/multiplexing steps for uplink and downlink are shown in figure 1 and figure 2 respectively.

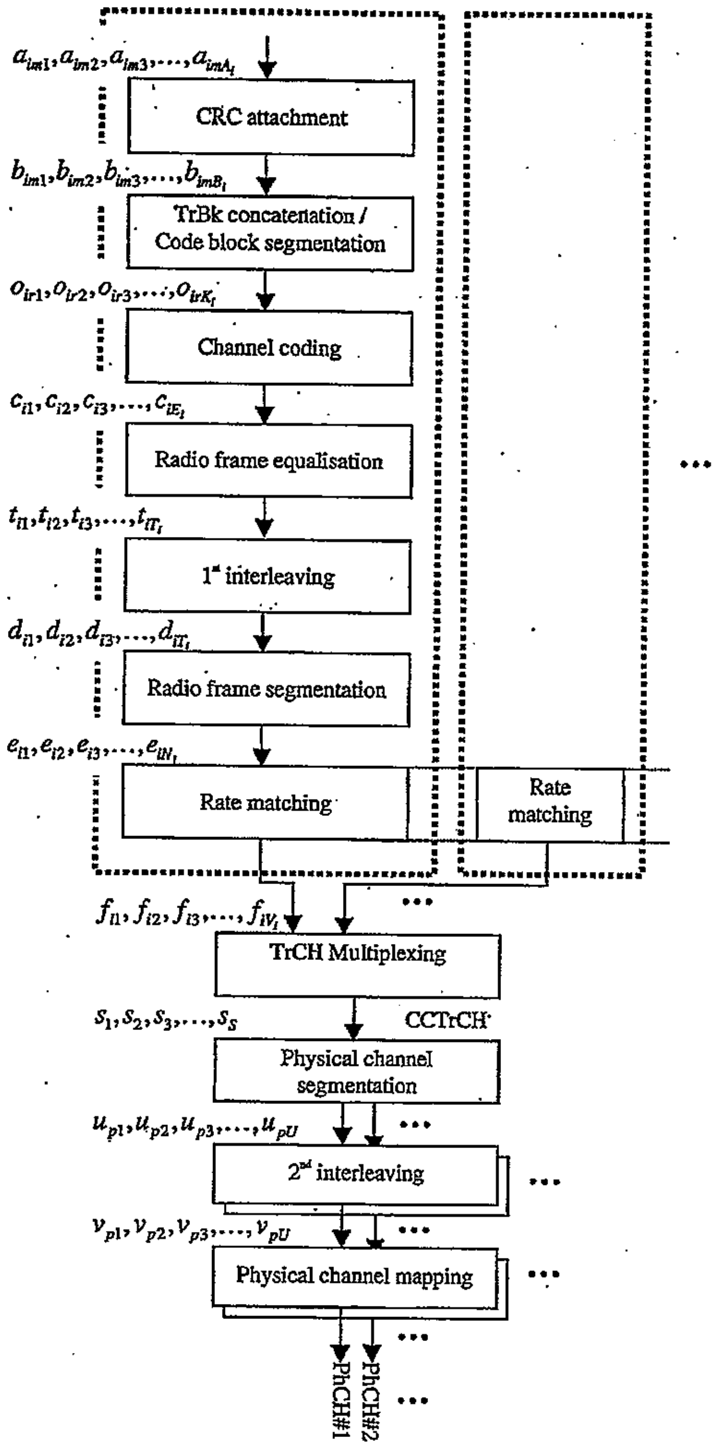


Figure 1: Transport channel multiplexing structure for uplink

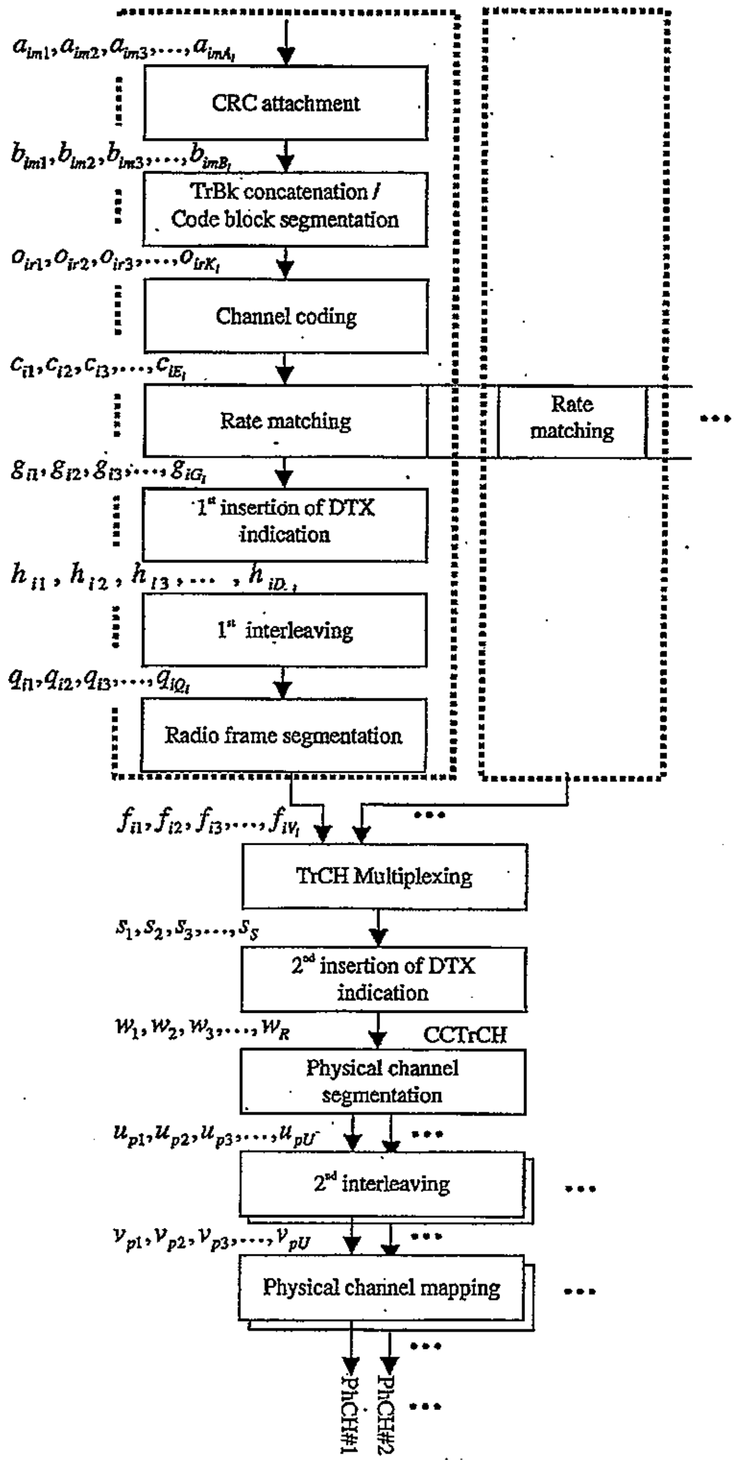


Figure 2: Transport channel multiplexing structure for downlink

The single output data stream from the TrCH multiplexing, including DTX indication bits in downlink, is denoted *Coded Composite Transport Channel (CCTrCH)*. A CCTrCH can be mapped to one or several physical channels.

4.2.1 CRC attachment

Error detection is provided on transport blocks through a Cyclic Redundancy Check (CRC). The size of the CRC is 24, 16, 12, 8 or 0 bits and it is signalled from higher layers what CRC size that should be used for each TrCH.

4.2.1.1 CRC Calculation

The entire transport block is used to calculate the CRC parity bits for each transport block. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24}(D) = D^{24} + D^{23} + D^6 + D^5 + D + 1;$
- $g_{CRC16}(D) = D^{16} + D^{12} + D^5 + 1;$
- $g_{CRC12}(D) = D^{12} + D^{11} + D^3 + D^2 + D + 1;$
- $g_{CRC8}(D) = D^8 + D^7 + D^4 + D^3 + D + 1.$

Denote the bits in a transport block delivered to layer 1 by $a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$, and the parity bits by $p_{im1}, p_{im2}, p_{im3}, \ldots, p_{imL_i}$. A_i is the size of a transport block of TrCH i, m is the transport block number, and L_i is the number of parity bits. L_i can take the values 24, 16, 12, 8, or 0 depending on what is signalled from higher layers.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_{im1}D^{A_i+23} + a_{im2}D^{A_i+22} + \ldots + a_{imA_i}D^{24} + p_{im1}D^{23} + p_{im2}D^{22} + \ldots + p_{im23}D^1 + p_{im24}$$

yields a remainder equal to 0 when divided by $g_{CRC24}(D)$, polynomial:

$$a_{im1}D^{A_i+15} + a_{im2}D^{A_i+14} + \ldots + a_{imA_i}D^{16} + p_{im1}D^{15} + p_{im2}D^{14} + \ldots + p_{im15}D^1 + p_{im16}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, polynomial:

$$a_{im1}D^{A_i+11} + a_{im2}D^{A_i+10} + \ldots + a_{imA_i}D^{12} + p_{im1}D^{11} + p_{im2}D^{10} + \ldots + p_{im11}D^1 + p_{im12}$$

yields a remainder equal to 0 when divided by $g_{CRC12}(D)$ and polynomial:

$$a_{im1}D^{A_i+7} + a_{im2}D^{A_i+6} + \ldots + a_{imA_i}D^{8} + p_{im1}D^{7} + p_{im2}D^{6} + \ldots + p_{im7}D^1 + p_{im8}$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

If no transport blocks are input to the CRC calculation ($M_i = 0$), no CRC attachment shall be done. If transport blocks are input to the CRC calculation ($M_i \neq 0$) and the size of a transport block is zero ($A_i = 0$), CRC shall be attached, i.e. all parity bits equal to zero.

4.2.1.2 Relation between input and output of the CRC attachment block

The bits after CRC attachment are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$, where $B_i = A_i + L_i$. The relation between a_{imk} and b_{imk} is:

$$b_{imk} = a_{imk} \qquad k = 1, 2, 3, \ldots, A_i$$

$$b_{imk} = p_{im(L_i+1-(k-A_i))} \qquad k = A_i + 1, A_i + 2, A_i + 3, \ldots, A_i + L_i$$

4.2.2 Transport block concatenation and code block segmentation

All transport blocks in a TTI are serially concatenated. If the number of bits in a TTI is larger than Z, the maximum size of a code block in question, then code block segmentation is performed after the concatenation of the transport blocks. The maximum size of the code blocks depends on whether convolutional coding or turbo coding is used for the TrCH.

4.2.2.1 Concatenation of transport blocks

The bits input to the transport block concatenation are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$ where i is the TrCH number, m is the transport block number, and B_i is the number of bits in each block (including CRC). The number of transport blocks on TrCH i is denoted by M_i. The bits after concatenation are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where i is the TrCH number and X_i=M_iB_i. They are defined by the following relations:

$$x_{ik} = b_{i1k} \qquad k = 1, 2, \ldots, B_i$$

$$x_{ik} = b_{i,2,(k-B_i)} \qquad k = B_i + 1, B_i + 2, \ldots, 2B_i$$

$$x_{ik} = b_{i,3,(k-2B_i)} \qquad k = 2B_i + 1, 2B_i + 2, \ldots, 3B_i$$

...

$$x_{ik} = b_{i,M_i,(k-(M_i-1)B_i)} \qquad k = (M_i - 1)B_i + 1, (M_i - 1)B_i + 2, \ldots, M_iB_i$$

4.2.2.2 Code block segmentation

Segmentation of the bit sequence from transport block concatenation is performed if X_i>Z. The code blocks after segmentation are of the same size. The number of code blocks on TrCH i is denoted by C_i. If the number of bits input to the segmentation, X_i, is not a multiple of C_i, filler bits are added to the beginning of the first block. If turbo coding is selected and $X_i < 40$, filler bits are added to the beginning of the code block. The filler bits are transmitted and they are always set to 0. The maximum code block sizes are:

- convolutional coding: $Z = 504$;
- turbo coding: $Z = 5114$.

The bits output from code block segmentation, for $C_i \neq 0$, are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits per code block.

Number of code blocks:

$${}_i = \lceil X_i / Z \rceil$$

Number of bits in each code block (applicable for $C_i \neq 0$ only):

if $X_i < 40$ and Turbo coding is used, then

$K_i = 40$

else

$K_i = \lceil X_i / C_i \rceil$

end if

Number of filler bits: $Y_i = C_iK_i - X_i$

for $k = 1$ to Y_i -- Insertion of filler bits

$o_{i1k} = 0$

end for

for $k = Y_i$+1 to K_i

$o_{i1k} = x_{i,(k-Y_i)}$

end for

$r = 2$ -- Segmentation

while $r \le C_i$

for $k = 1$ to K_i

$o_{irk} = x_{i,(k+(r-1)\cdot K_i - Y_i)}$

end for

$r = r+1$

end while

4.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits in each code block. The number of code blocks on TrCH i is denoted by C_i. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$, where Y_i is the number of encoded bits. The relation between o_{irk} and y_{irk} and between K_i and Y_i is dependent on the channel coding scheme.

The following channel coding schemes can be applied to TrCHs:

- convolutional coding;
- turbo coding.

Usage of coding scheme and coding rate for the different types of TrCH is shown in table 1.

The values of Y_i in connection with each coding scheme:

- convolutional coding with rate 1/2: $Y_i = 2*K_i + 16$; rate 1/3: $Y_i = 3*K_i + 24$;
- turbo coding with rate 1/3: $Y_i = 3*K_i + 12$.

Table 1: Usage of channel coding scheme and coding rate

Type of TrCH	Coding scheme	Coding rate
BCH	Convolutional coding	1/2
PCH		
RACH		
DCH, FACH		1/3, 1/2
	Turbo coding	1/3

4.2.3.1 Convolutional coding

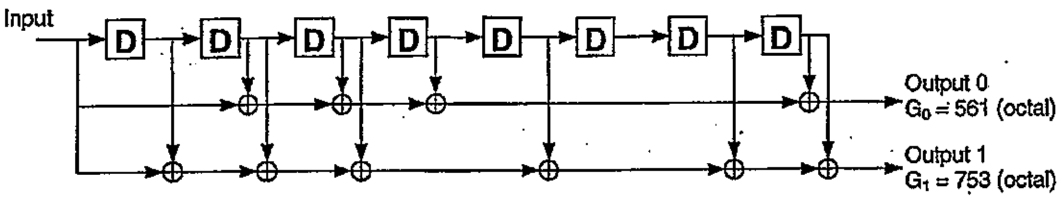
Convolutional codes with constraint length 9 and coding rates 1/3 and 1/2 are defined.

The configuration of the convolutional coder is presented in figure 3.

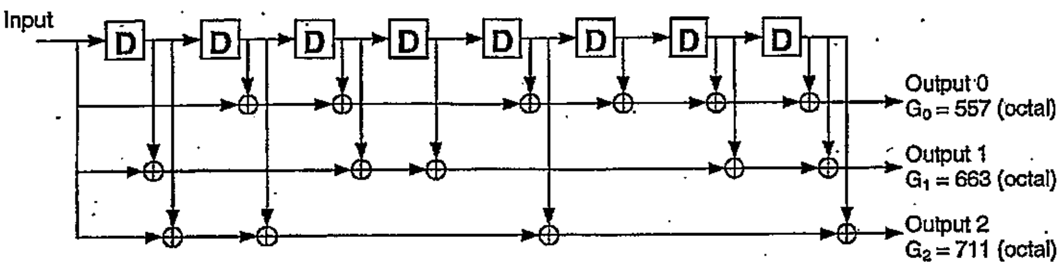
Output from the rate 1/3 convolutional coder shall be done in the order output0, output1, output2, output0, output1, output 2, output 0,...,output2. Output from the rate 1/2 convolutional coder shall be done in the order output 0, output 1, output 0, output 1, output 0, ..., output 1.

8 tail bits with binary value 0 shall be added to the end of the code block before encoding.

The initial value of the shift register of the coder shall be "all 0" when starting to encode the input bits.



(a) Rate 1/2 convolutional coder



(b) Rate 1/3 convolutional coder

Figure 3: Rate 1/2 and rate 1/3 convolutional coders

4.2.3.2 Turbo coding

4.2.3.2.1 Turbo coder

The scheme of Turbo coder is a Parallel Concatenated Convolutional Code (PCCC) with two 8-state constituent encoders and one Turbo code internal interleaver. The coding rate of Turbo coder is 1/3. The structure of Turbo coder is illustrated in figure 4.

The transfer function of the 8-state constituent code for PCCC is:

$$G(D) = \left[1, \frac{g_1(D)}{g_0(D)}\right],$$

where

$$g_0(D) = 1 + D^2 + D^3,$$

$$g_1(D) = 1 + D + D^3.$$

The initial value of the shift registers of the 8-state constituent encoders shall be all zeros when starting to encode the input bits.

Output from the Turbo coder is

$$x_1, z_1, z'_1, x_2, z_2, z'_2, \ldots, x_K, z_K, z'_K,$$

where $x_1, x_2, \ldots, x_K$ are the bits input to the Turbo coder i.e. both first 8-state constituent encoder and Turbo code internal interleaver, and K is the number of bits, and $z_1, z_2, \ldots, z_K$ and $z'_1, z'_2, \ldots, z'_K$ are the bits output from first and second 8-state constituent encoders, respectively.

The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, and these bits are to be input to the second 8-state constituent encoder.

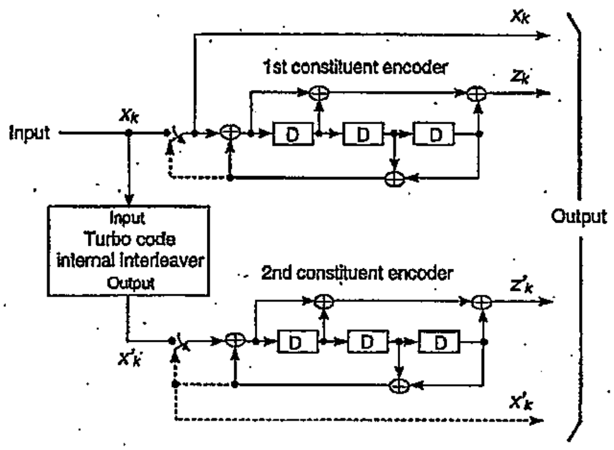


Figure 4: Structure of rate 1/3 Turbo coder (dotted lines apply for trellis termination only)

4.2.3.2.2 Trellis termination for Turbo coder

Trellis termination is performed by taking the tail bits from the shift register feedback after all information bits are encoded. Tail bits are padded after the encoding of information bits.

The first three tail bits shall be used to terminate the first constituent encoder (upper switch of figure 4 in lower position) while the second constituent encoder is disabled. The last three tail bits shall be used to terminate the second constituent encoder (lower switch of figure 4 in lower position) while the first constituent encoder is disabled.

The transmitted bits for trellis termination shall then be:

$$x_{K+1}, z_{K+1}, x_{K+2}, z_{K+2}, x_{K+3}, z_{K+3}, x'_{K+1}, z'_{K+1}, x'_{K+2}, z'_{K+2}, x'_{K+3}, z'_{K+3}.$$

4.2.3.2.3 Turbo code internal interleaver

The Turbo code internal interleaver consists of bits-input to a rectangular matrix with padding, intra-row and inter-row permutations of the rectangular matrix, and bits-output from the rectangular matrix with pruning. The bits input to the Turbo code internal interleaver are denoted by $x_1, x_2, x_3, \ldots, x_K$, where K is the integer number of the bits and takes one value of $40 \le K \le 5114$. The relation between the bits input to the Turbo code internal interleaver and the bits input to the channel coding is defined by $x_k = o_{irk}$ and $K = K_i$.

The following subclause specific symbols are used in subclauses 4.2.3.2.3.1 to 4.2.3.2.3.3:

K	Number of bits input to Turbo code internal interleaver
R	Number of rows of rectangular matrix
C	Number of columns of rectangular matrix
p	Prime number
v	Primitive root
$\langle s(j) \rangle_{j \in \{0,1,\ldots,p-2\}}$	Base sequence for intra-row permutation
q_i	Minimum prime integers
r_i	Permuted prime integers

$\langle T(i) \rangle_{i\in\{0,1,\cdots,R-1\}}$ Inter-row permutation pattern

$\langle U_i(j) \rangle_{j\in\{0,1,\cdots,C-1\}}$ Intra-row permutation pattern of i-th row

i Index of row number of rectangular matrix

j Index of column number of rectangularmatrix

k Index of bit sequence

4.2.3.2.3.1 Bits-input to rectangular matrix with padding

The bit sequence $x_1, x_2, x_3, \ldots, x_K$ input to the Turbo code internal interleaver is written into the rectangular matrix as follows.

(1) Determine the number of rows of the rectangular matrix, R, such that:

$$R = \begin{cases} 5, \text{if } (40 \le K \le 159) \\ 10, \text{if } ((160 \le K \le 200) \text{ or } (481 \le K \le 530)) \\ 20, \text{if } (K = \text{any other value}) \end{cases}.$$

The rows of rectangular matrix are numbered 0, 1, …, R - 1 from top to bottom.

(2) Determine the prime number to be used in the intra-permutation, p, and the number of columns of rectangular matrix, C, such that:

if (481 $\le K \le$ 530) then

$p = 53$ and $C = p$.

else

Find minimum prime number p from table 2 such that

$K \le R \times (p+1)$,

and determine C such that

$$C = \begin{cases} p-1 & \text{if } K \le R \times (p-1) \\ p & \text{if } R \times (p-1) < K \le R \times p \\ p+1 & \text{if } R \times p < K \end{cases}.$$

end if

The columns of rectangular matrix are numbered 0, 1, …, C - 1 from left to right.

Table 2: List of prime number *p* and associated primitive root *v*

p	v	p	v	p	v	p	v	p	v
7	3	47	5	101	2	157	5	223	3
11	2	53	2	103	5	163	2	227	2
13	2	59	2	107	2	167	5	229	6
17	3	61	2	109	6	173	2	233	3
19	2	67	2	113	3	179	2	239	7
23	5	71	7	127	3	181	2	241	7
29	2	73	5	131	2	191	19	251	6
31	3	79	3	137	3	193	5	257	3
37	2	83	2	139	2	197	2		
41	6	89	3	149	2	199	3		
43	3	97	5	151	6	211	2		

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_K$ into the $R \times C$ rectangular matrix row by row starting with bit y_1 in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \cdots & y_C \\ y_{(C+1)} & y_{(C+2)} & y_{(C+3)} & \cdots & y_{2C} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{((R-1)C+1)} & y_{((R-1)C+2)} & y_{((R-1)C+3)} & \cdots & y_{R\times C} \end{bmatrix}$$

where $y_k = x_k$ for $k = 1, 2, \ldots, K$ and if $R\times C > K$, the dummy bits are padded such that $y_k = 0 or 1$ for $k = K+1, K+2, \ldots, R\times C$. These dummy bits are pruned away from the output of the rectangular matrix after intra-row and inter-row permutations.

4.2.3.2.3.2 Intra-row and inter-row permutations

After the bits-input to the $R\times C$ rectangular matrix, the intra-row and inter-row permutations for the $R\times C$ rectangular matrix are performed stepwise by using the following algorithm with steps (1) – (6):

(1) Select a primitive root v from table 2 in section 4.2.3.2.3.1, which is indicated on the right side of the prime number p.

(2) Construct the base sequence $\langle s(j) \rangle_{j\in\{0,1,\cdots,p-2\}}$ for intra-row permutation as:

$s(j) = (v \times s(j-1)) \bmod p$, $j = 1, 2,\ldots, (p - 2)$, and $s(0) = 1$.

(3) Assign $q_0 = 1$ to be the first prime integer in the sequence $\langle q_i \rangle_{i\in\{0,1,\cdots,R-1\}}$, and determine the prime integer q_i in the sequence $\langle q_i \rangle_{i\in\{0,1,\cdots,R-1\}}$ to be a least prime integer such that g.c.d(q_i, p - 1) = 1, $q_i > 6$, and $q_i > q_{(i-1)}$ for each $i = 1, 2, \ldots, R-1$. Here g.c.d. is greatest common divisor.

(4) Permute the sequence $\langle q_i \rangle_{i\in\{0,1,\cdots,R-1\}}$ to make the sequence $\langle r_i \rangle_{i\in\{0,1,\cdots,R-1\}}$ such that

$r_{T(i)} = q_i$, $i = 0, 1, \ldots, R - 1$,

where $\langle T(i) \rangle_{i\in\{0,1,\cdots,R-1\}}$ is the inter-row permutation pattern defined as the one of the four kind of patterns, which are shown in table 3, depending on the number of input bits K.

Table 3: Inter-row permutation patterns for Turbo code internal interleaver

Number of input bits K	Number of rows R	Inter-row permutation patterns <$T(0)$, $T(1)$, ..., $T(R-1)$>
$(40 \le K \le 159)$	5	<4, 3, 2, 1, 0>
$(160 \le K \le 200)$ or $(481 \le K \le 530)$	10	<9, 8, 7, 6, 5, 4, 3, 2, 1, 0>
$(2281 \le K \le 2480)$ or $(3161 \le K \le 3210)$	20	<19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 16, 13, 17, 15, 3, 1, 6, 11, 8, 10>
K = any other value	20	<19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 10, 8, 13, 17, 3, 1, 16, 6, 15, 11>

(5) Perform the i-th ($i = 0, 1, \ldots, R-1$) intra-row permutation as:

if ($C = p$) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j = 0, 1, \ldots, (p-2)$, and $U_i(p-1) = 0$,

where $U_i(j)$ is the original bit position of j-th permuted bit of i-th row.

end if

if ($C = p + 1$) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j = 0, 1, \ldots, (p-2)$. $U_i(p-1) = 0$, and $U_i(p) = p$,

where $U_i(j)$ is the original bit position of j-th permuted bit of i-th row, and

if ($K = R \times C$) then

Exchange $U_{R-1}(p)$ with $U_{R-1}(0)$.

end if

end if

if ($C = p - 1$) then

$U_i(j) = s((j \times r_i) \bmod (p-1)) - 1$, $j = 0, 1, \ldots, (p-2)$,

where $U_i(j)$ is the original bit position of j-th permuted bit of i-th row.

end if

(6) Perform the inter-row permutation for the rectangular matrix based on the pattern $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$,

where $T(i)$ is the original row position of the i-th permuted row.

4.2.3.2.3.3 Bits-output from rectangular matrix with pruning

After intra-row and inter-row permutations, the bits of the permuted rectangular matrix are denoted by y'_k:

$$\begin{bmatrix} y'_1 & y'_{(R+1)} & y'_{(2R+1)} & \cdots & y'_{((C-1)R+1)} \\ y'_2 & y'_{(R+2)} & y'_{(2R+2)} & \cdots & y'_{((C-1)R+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y'_R & y'_{2R} & y'_{3R} & \cdots & y'_{C \times R} \end{bmatrix}$$

The output of the Turbo code internal interleaver is the bit sequence read out column by column from the intra-row and inter-row permuted $R \times C$ rectangular matrix starting with bit y'_1 in row 0 of column 0 and ending with bit y'_{CR} in row R - 1 of column C - 1. The output is pruned by deleting dummy bits that were padded to the input of the rectangular matrix before intra-row and inter row permutations, i.e. bits y'_k that corresponds to bits y_k with $k > K$ are removed from the output. The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, ..., x'_K$, where x'_1 corresponds to the bit y'_k with smallest index k after pruning, x'_2 to the bit y'_k with second smallest index k after pruning, and so on. The number of bits output from Turbo code internal interleaver is K and the total number of pruned bits is:

$R \times C - K$.

4.2.3.3 Concatenation of encoded blocks

After the channel coding for each code block, if C_i is greater than 1, the encoded blocks are serially concatenated so that the block with lowest index r is output first from the channel coding block, otherwise the encoded block is output from channel coding block as it is. The bits output are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is the TrCH number and $E_i = C_i Y_i$. The output bits are defined by the following relations:

$$c_{ik} = y_{i1k} \quad k = 1, 2, ..., Y_i$$

$$c_{ik} = y_{i,2,(k-Y_i)} \quad k = Y_i + 1, Y_i + 2, ..., 2Y_i$$

$$c_{ik} = y_{i,3,(k-2Y_i)} \quad k = 2Y_i + 1, 2Y_i + 2, ..., 3Y_i$$

...

$$c_{ik} = y_{i,C_i,(k-(C_i-1)Y_i)} \quad k = (C_i - 1)Y_i + 1, (C_i - 1)Y_i + 2, ..., C_iY_i$$

If no code blocks are input to the channel coding ($C_i = 0$), no bits shall be output from the channel coding, i.e. $E_i = 0$.

4.2.4 Radio frame size equalisation

Radio frame size equalisation is padding the input bit sequence in order to ensure that the output can be segmented in F_i data segments of same size as described in subclause 4.2.7. Radio frame size equalisation is only performed in the UL.

The input bit sequence to the radio frame size equalisation is denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is TrCH number and E_i the number of bits. The output bit sequence is denoted by $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where T_i is the number of bits. The output bit sequence is derived as follows:

- $t_{ik} = c_{ik}$, for k = 1… E_i; and
- $t_{ik} = \{0, 1\}$ for k= E_i +1… T_i, if $E_i < T_i$;

where

- $T_i = F_i * N_i$; and
- $N_i = \lceil E_i / F_i \rceil$ is the number of bits per segment after size equalisation.

4.2.5 1st interleaving

4.2.5.1 Void

4.2.5.2 1st interleaver operation

The 1st interleaving is a block interleaver with inter-column permutations. The input bit sequence to the block interleaver is denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$, where i is TrCH number and X_i the number of bits. Here X_i is

guaranteed to be an integer multiple of the number of radio frames in the TTI. The output bit sequence from the block interleaver is derived as follows:

(1) Select the number of columns C1 from table 4 depending on the TTI. The columns are numbered 0, 1, ..., C1 - 1 from left to right.

(2) Determine the number of rows of the matrix, R1 defined as

$$R1 = X_i / C1.$$

The rows of the matrix are numbered 0, 1, ..., R1 - 1 from top to bottom.

(3) Write the input bit sequence into the R1 × C1 matrix row by row starting with bit $x_{i,1}$ in column 0 of row 0 and ending with bit $x_{i,(R1\times C1)}$ in column C1 - 1 of row R1 - 1:

$$\begin{bmatrix} x_{i,1} & x_{i,2} & x_{i,3} & \cdots & x_{i,C1} \\ x_{i,(C1+1)} & x_{i,(C1+2)} & x_{i,(C1+3)} & \cdots & x_{i,(2\times C1)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ x_{i,((R1-1)\times C1+1)} & x_{i,((R1-1)\times C1+2)} & x_{i,((R1-1)\times C1+3)} & \cdots & x_{i,(R1\times C1)} \end{bmatrix}$$

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle P1_{C1}(j) \rangle_{j\in\{0,1,\ldots,C1-1\}}$ shown in table 4, where $P1_{C1}(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by y_{ik}:

$$\begin{bmatrix} y_{i,1} & y_{i,(R1+1)} & y_{i,(2\times R1+1)} & \cdots & y_{i,((C1-1)\times R1+1)} \\ y_{i,2} & y_{i,(R1+2)} & y_{i,(2\times R1+2)} & \cdots & y_{i,((C1-1)\times R1+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{i,R1} & y_{i,(2\times R1)} & y_{i,(3\times R1)} & \cdots & y_{i,(C1\times R1)} \end{bmatrix}$$

(5) Read the output bit sequence $y_{i,1}, y_{i,2}, y_{i,3}, \ldots, y_{i,(C1\times R1)}$ of the block interleaver column by column from the inter-column permuted R1 × C1 matrix. Bit $y_{i,1}$ corresponds to row 0 of column 0 and bit $y_{i,(R1\times C1)}$ corresponds to row R1 - 1 of column C1 - 1.

Table 4 Inter-column permutation patterns for 1st interleaving

TTI	Number of columns C1	Inter-column permutation patterns <P1$_{C1}$(0), P1$_{C1}$(1), ..., P1$_{C1}$(C1-1)>
10 ms	1	<0>
20 ms	2	<0,1>
40 ms	4	<0,2,1,3>
80 ms	8	<0,4,2,6,1,5,3,7>

4.2.5.3 Relation between input and output of 1st interleaving in uplink

The bits input to the 1st interleaving are denoted by $t_{i,1}, t_{i,2}, t_{i,3}, \ldots, t_{i,T_i}$, where i is the TrCH number and T_i the number of bits. Hence, $x_{i,k} = t_{i,k}$ and $X_i = T_i$.

The bits output from the 1st interleaving are denoted by $d_{i,1}, d_{i,2}, d_{i,3}, \ldots, d_{i,T_i}$, and $d_{i,k} = y_{i,k}$.

4.2.5.4 Relation between input and output of 1st interleaving in downlink

If fixed positions of the TrCHs in a radio frame is used then the bits input to the 1st interleaving are denoted by $h_{i1}, h_{i2}, h_{i3}, \ldots, h_{iD_i}$, where i is the TrCH number. Hence, $x_{ik} = h_{ik}$ and $X_i = D_i$.

If flexible positions of the TrCHs in a radio frame is used then the bits input to the 1st interleaving are denoted by $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where i is the TrCH number. Hence, $x_{ik} = g_{ik}$ and $X_i = G_i$.

The bits output from the 1st interleaving are denoted by $q_{i1}, q_{i2}, q_{i3}, \ldots, q_{iQ_i}$, where i is the TrCH number and Q_i is the number of bits. Hence, $q_{ik} = y_{ik}$, $Q_i = F_i H_i$ if fixed positions are used, and $Q_i = G_i$ if flexible positions are used.

4.2.6 Radio frame segmentation

When the transmission time interval is longer than 10 ms, the input bit sequence is segmented and mapped onto consecutive F_i radio frames. Following rate matching in the DL and radio frame size equalisation in the UL the input bit sequence length is guaranteed to be an integer multiple of F_i.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where i is the TrCH number and X_i is the number bits. The F_i output bit sequences per TTI are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where n_i is the radio frame number in current TTI and Y_i is the number of bits per radio frame for TrCH i. The output sequences are defined as follows:

$$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}, \; n_i = 1 \ldots F_i, \; k = 1 \ldots Y_i$$

where

$Y_i = (X_i / F_i)$ is the number of bits per segment.

The n_i-th segment is mapped to the n_i-th radio frame of the transmission time interval.

4.2.6.1 Relation between input and output of the radio frame segmentation block in uplink

The input bit sequence to the radio frame segmentation is denoted by $d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$, where i is the TrCH number and T_i the number of bits. Hence, $x_{ik} = d_{ik}$ and $X_i = T_i$.

The output bit sequence corresponding to radio frame n_i is denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where i is the TrCH number and N_i is the number of bits. Hence, $e_{i,k} = y_{i,n_ik}$ and $N_i = Y_i$.

4.2.6.2 Relation between input and output of the radio frame segmentation block in downlink

The bits input to the radio frame segmentation are denoted by $q_{i1}, q_{i2}, q_{i3}, \ldots, q_{iQ_i}$, where i is the TrCH number and Q_i the number of bits. Hence, $x_{ik} = q_{ik}$ and $X_i = Q_i$.

The output bit sequence corresponding to radio frame n_i is denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where i is the TrCH number and V_i is the number of bits. Hence, $f_{i,k} = y_{i,n_ik}$ and $V_i = Y_i$.

4.2.7 Rate matching

Rate matching means that bits on a transport channel are repeated or punctured. Higher layers assign a rate-matching attribute for each transport channel. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a transport channel can vary between different transmission time intervals. In the downlink the transmission is interrupted if the number of bits is lower than maximum. When the number of bits between different transmission time intervals in uplink is changed, bits are repeated or punctured to ensure that the total bit rate after TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated physical channels.

If no bits are input to the rate matching for all TrCHs within a CCTrCH, the rate matching shall output no bits for all TrCHs within the CCTrCH and no uplink DPDCH will be selected in the case of uplink rate matching.

Notation used in subclause 4.2.7 and subclauses:

$N_{i,j}$: For uplink: Number of bits in a radio frame before rate matching on TrCH i with transport format combination j.

For downlink: An intermediate calculation variable (not an integer but a multiple of 1/8).

$N_{i,l}^{TTI}$: Number of bits in a transmission time interval before rate matching on TrCH i with transport format l. Used in downlink only.

$\Delta N_{i,j}$: For uplink: If positive - number of bits that should be repeated in each radio frame on TrCH i with transport format combination j.

If negative - number of bits that should be punctured in each radio frame on TrCH i with transport format combination j.

For downlink : An intermediate calculation variable (not an integer but a multiple of 1/8).

$\Delta N_{i,l}^{TTI}$: If positive - number of bits to be repeated in each transmission time interval on TrCH i with transport format l.

If negative - number of bits to be punctured in each transmission time interval on TrCH i with transport format l.

Used in downlink only.

N_{TGL}: Positive or null: number of bits in the radio frame corresponding to the gap for compressed mode for the CCTrCH.

RM_i: Semi-static rate matching attribute for transport channel i. RM_i is provided by higher layers or takes a value as indicated in section 4.2.13.

PL: Puncturing limit for uplink. This value limits the amount of puncturing that can be applied in order to avoid multicode or to enable the use of a higher spreading factor. Signalled from higher layers. The allowed puncturing in % is actually equal to (1-PL)*100.

$N_{data,j}$: Total number of bits that are available for the CCTrCH in a radio frame with transport format combination j.

I: Number of TrCHs in the CCTrCH.

$Z_{i,j}$: Intermediate calculation variable.

F_i: Number of radio frames in the transmission time interval of TrCH i.

n_i: Radio frame number in the transmission time interval of TrCH i ($0 \le n_i < F_i$).

q: Average puncturing or repetition distance (normalised to only show the remaining rate matching on top of an integer number of repetitions). Used in uplink only.

$P1_F(n_i)$: The column permutation function of the 1st interleaver, $P1_F(x)$ is the original position of column with number x after permutation. P1 is defined on table 4 of section 4.2.5.2 (note that the $P1_F$ is self-inverse). Used for rate matching in uplink only.

$S[n]$: The shift of the puncturing or repetition pattern for radio frame n_i when $n = P1_{F_i}(n_i)$. Used in uplink only.

$TF_i(j)$: Transport format of TrCH *i* for the transport format combination *j*.

$TFS(i)$ The set of transport format indexes *l* for TrCH *i*.

TFCS The set of transport format combination indexes *j*.

e_{ini} Initial value of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of subclause4.2.7.5.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

b: Indicates systematic and parity bits

b=1: Systematic bit. x_k in subclause 4.2.3.2.1.

b=2: 1[st] parity bit (from the upper Turbo constituent encoder). z_k in subcaluse 4.2.3.2.1.

b=3: 2[nd] parity bit (from the lower Turbo constituent encoder). z'_k in subclause 4.2.3.2.1.

The * (star) notation is used to replace an index *x* when the indexed variable X_x does not depend on the index *x*. In the left wing of an assignment the meaning is that "$X_* = Y$" is equivalent to "for all *x* do $X_x = Y$". In the right wing of an assignment, the meaning is that "$Y = X_*$" is equivalent to "take any *x* and do $Y = X_x$".

The following relations, defined for all TFC *j*, are used when calculating the rate matching parameters:

$$Z_{0,j} = 0$$

$$Z_{i,j} = \left\lfloor \frac{\left(\left(\sum_{m=1}^{i} RM_m \times N_{m,j} \right) \times N_{data,j} \right)}{\sum_{m=1}^{I} RM_m \times N_{m,j}} \right\rfloor \text{ for all } i = 1 \ldots I \qquad (1)$$

$$\Delta N_{i,j} = Z_{i,j} - Z_{i-1,j} - N_{i,j} \text{ for all } i = 1 \ldots I$$

4.2.7.1 Determination of rate matching parameters in uplink

4.2.7.1.1 Determination of SF and number of PhCHs needed

In uplink, puncturing can be applied to match the CCTrCH bit rate to the PhCH bit rate. The bit rate of the PhCH(s) is limited by the UE capability and restrictions imposed by UTRAN, through limitations on the PhCH spreading factor. The maximum amount of puncturing that can be applied is 1-PL, PL is signalled from higher layers. The number of available bits in the radio frames of one PhCH for all possible spreading factors is given in [2]. Denote these values by N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, and N_4, where the index refers to the spreading factor. The possible number of bits available to the CCTrCH on all PhCHs, N_{data}, then are { N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2\times N_4$, $3\times N_4$, $4\times N_4$, $5\times N_4$, $6\times N_4$}.

For a RACH CCTrCH SET0 represents the set of N_{data} values allowed by the UTRAN, as set by the minimum SF provided by higher layers. SET0 may be a sub-set of { N_{256}, N_{128}, N_{64}, N_{32} }. SET0 does not take into account the UE"s capability.

For other CCTrCHs, SET0 denotes the set of N_{data} values allowed by the UTRAN and supported by the UE, as part of the UE"s capability. SET0 can be a subset of { N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2\times N_4$, $3\times N_4$, $4\times N_4$, $5\times N_4$, $6\times N_4$}. $N_{data,j}$ for the transport format combination *j* is determined by executing the following algorithm:

SET1 = { N_{data} in SET0 such that $\left(\min_{1 \le y \le I} \{RM_y\} \right) \times N_{data} - \sum_{x=1}^{I} RM_x \times N_{x,j}$ is non negative }

If SET1 is not empty and the smallest element of SET1 requires just one PhCH then

$N_{data,j}$ = min SET1

else

SET2 = { N_{data} in SET0 such that $\left(\min\limits_{1\le y\le I}\{RM_y\}\right)\times N_{data} - PL\times\sum_{x=1}^{I} RM_x \times N_{x,j}$ is non negative }

Sort SET2 in ascending order

N_{data} = min SET2

While N_{data} is not the max of SET2 and the follower of N_{data} requires no additional PhCH do

N_{data} = follower of N_{data} in SET2

End while

$N_{data,j} = N_{data}$

End if

For a RACH CCTrCH, if $N_{data,j}$ is not part of the UE"s capability then the TFC j cannot be used.

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

The number of bits to be repeated or punctured, $\Delta N_{i,j}$, within one radio frame for each TrCH i is calculated with equation 1 for all possible transport format combinations j and selected every radio frame. $N_{data,j}$ is given from subclause 4.2.7.1.1.

In a compressed radio frame, $N_{data,j}$ is replaced by $N_{data,j}^{cm}$ in Equation 1. $N_{data,j}^{cm}$ is given as follows:

In a radio frame compressed by higher layer scheduling, $N_{data,j}^{cm}$ is obtained by executing the algorithm in subclause 4.2.7.1.1 but with the number of bits in one radio frame of one PhCH reduced to $\frac{N_{tr}}{15}$ of the value in normal mode.

N_{tr} is the number of transmitted slots in a compressed radio frame and is defined by the following relation:

$$N_{tr} = \begin{cases} 15 - TGL, \text{ if } N_{first} + TGL \le 15 \\ N_{first}, \text{ in first frame if } N_{first} + TGL > 15 \\ 30 - TGL - N_{first}, \text{ in second frame if } N_{first} + TGL > 15 \end{cases}$$

N_{first} and TGL are defined in subclause 4.4.

In a radio frame compressed by spreading factor reduction, $N_{data,j}^{cm} = 2\times(N_{data,j} - N_{TGL})$, where

$$N_{TGL} = \frac{15 - N_{tr}}{15}\times N_{data,j}$$

If $\Delta N_{i,j} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed.

If $\Delta N_{i,j} \ne 0$ the parameters listed in subclauses 4.2.7.1.2.1 and 4.2.7.1.2.2 shall be used for determining e_{ini}, e_{plus}, and e_{minus} (regardless if the radio frame is compressed or not).

4.2.7.1.2.1 Convolutionally encoded TrCHs

$R = \Delta N_{i,j} \bmod N_{i,j}$ – note: in this context $\Delta N_{i,j} \bmod N_{i,j}$ is in the range of 0 to $N_{i,j}$-1 i.e. -1 mod 10 = 9.

if $R \ne 0$ and $2\times R \le N_{ij}$

then $q = \lceil N_{i,j} / R \rceil$

else

$q = \lceil N_{i,j} / (R - N_{i,j}) \rceil$

endif

– note: q is a signed quantity.

if q is even

then $q' = q + \gcd(|q|, F_i)/F_i$ – where $\gcd(|q|, F_i)$ means greatest common divisor of $|q|$ and F_i

– note that q' is not an integer, but a multiple of 1/8

else

$q' = q$

endif

for $x = 0$ to $F_i - 1$

$S[|\lfloor x \times q' \rfloor| \bmod F_i] = (|\lfloor x \times q' \rfloor| \operatorname{div} F_i)$

end for

$\Delta N_i = \Delta N_{i,j}$

$a = 2$

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5, where :

$X_i = N_{i,j}$, and

$e_{ini} = (a \times S[P1_{F_i}(n_i)] \times |\Delta N_i| + 1) \bmod (a \cdot N_{ij})$.

$e_{plus} = a \times N_{i,j}$

$e_{minus} = a \times |\Delta N_i|$

puncturing for $\Delta N < 0$, repetition otherwise.

4.2.7.1.2.2 Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j} > 0$, the parameters in subclause 4.2.7.1.2.1 are used.

If puncturing is to be performed, the parameters below shall be used. Index b is used to indicate systematic (b=1), 1st parity (b=2), and 2nd parity bit (b=3).

a=2 when b=2

a=1 when b=3

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor, & b=2 \\ \lceil \Delta N_{i,j}/2 \rceil, & b=3 \end{cases}$$

If ΔN_i is calculated as 0 for b=2 or b=3, then the following procedure and the rate matching algorithm of subclause 4.2.7.5 don't need to be performed for the corresponding parity bit stream.

$X_i = \lfloor N_{i,j}/3 \rfloor$,

$q = \lfloor X_i / |\Delta N_i| \rfloor$

if($q \le 2$)

for r=0 to F_l-1

S[(3×r+b-1) mod F_l] = r mod 2;

end for

else

if q is even

then q' = q – gcd(q, F_i)/ F_i -- where gcd (q, F_i) means greatest common divisor of q and F_i
-- note that q' is not an integer, but a multiple of 1/8

else q' = q

endif

for x=0 to F_i -1

r = $\lceil x \times q' \rceil$ mod F_i;

S[(3×r+b-1) mod F_l] = $\lceil x \times q' \rceil$ div F_i;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5, where:

X_i is as above:

e_{ini} = (a×S[P1$_{Fi}$(n_i)] ×|ΔN$_i$| + X$_i$) mod (a×X_i), if e_{ini} =0 then e_{ini} = a×X_i

e_{plus} = a×X_i

e_{minus} = a× |ΔN_i |

4.2.7.2 Determination of rate matching parameters in downlink

For downlink channels, $N_{data,j}$ does not depend on the transport format combination j. $N_{data,*}$ is given by the channelization code(s) assigned by higher layers.

Denote the number of physical channels used for the CCTrCH by P. $N_{data,*}$ is the number of bits available to the CCTrCH in one radio frame and defined as $N_{data,*}$=P×15×(N_{data1}+N_{data2}), where N_{data1} and N_{data2} are defined in [2]. Note that contrary to the uplink, the same rate matching patterns are used in TTIs containing no compressed radio frames and in TTIs containing radio frames compressed by spreading factor reduction or higher layer scheduling.

4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs

4.2.7.2.1.1 Calculation of $\Delta N_{i,max}$ for normal mode and compressed mode by spreading factor reduction

First an intermediate calculation variable $N_{i,*}$ is calculated for all transport channels i by the following formula:

$$N_{i,*} = \frac{1}{F_i} \times \left(\max_{l \in TFS(i)} N_{i,l}^{TTI} \right)$$

In order to compute the $\Delta N_{i,l}^{TTI}$ parameters for all TrCH i and all TF l, we first compute an intermediate parameter $\Delta N_{i,max}$ by the following formula, where $\Delta N_{i,*}$ is derived from $N_{i,*}$ by the formula given at subclause 4.2.7:

$$\Delta N_{i,max} = F_i \times \Delta N_{i,*}$$

If $\Delta N_{i,max} = 0$ then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed. In this case we have :

$$\forall l \in TFS(i)\ \Delta N_{i,l}^{TTI} = 0$$

If $\Delta N_{i,max} \neq 0$ the parameters listed in subclauses 4.2.7.2.1.3 and 4.2.7.2.1.4 shall be used for determining e_{ini}, e_{plus}, and e_{minus}, and $\Delta N_{i,l}^{TTI}$.

4.2.7.2.1.2 Void

4.2.7.2.1.3 Determination of rate matching parameters for convolutionally encoded TrCHs

$\Delta N_i = \Delta N_{i,max}$

a=2

$N_{max} = \max_{l \in TFS(i)} N_{il}^{TTI}$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5. The following parameters are used as input:

$X_i = N_{il}^{TTI}$

$e_{ini} = 1$

$e_{plus} = a \times N_{max}$

$e_{minus} = a \times |\Delta N_i|$

Puncturing if $\Delta N_i < 0$, repetition otherwise. The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting repetitions or puncturing when the algorithm of subclause 4.2.7.5 is run. The resulting values of $\Delta N_{i,l}^{TTI}$ can be represented with following expression.

$$\Delta N_{i,l}^{TTI} = \left\lceil \frac{|\Delta N_i| \times X_i}{N_{max}} \right\rceil \times \mathrm{sgn}(\Delta N_i)$$

4.2.7.2.1.4 Determination of rate matching parameters for Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,max} > 0$, the parameters in subclause 4.2.7.2.1.3 are used.

If puncturing is to be performed, the parameters below shall be used. Index *b* is used to indicate systematic (b=1), 1st parity (b=2), and 2nd parity bit (b=3).

a=2 when b=2

a=1 when b=3

The bits indicated by b=1 shall not be punctured.

$$\Delta N_i^b = \begin{cases} \lfloor \Delta N_{i,max}/2 \rfloor, & \text{for } b = 2 \\ \lceil \Delta N_{i,max}/2 \rceil, & \text{for } b = 3 \end{cases}$$

$$N_{max} = \max_{l \in TFS(i)} (N_{il}^{TTI} / 3)$$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in subcaluse 4.2.7.5. The following parameters are used as input:

$$X_i = N_{il}^{TTI} / 3$$

$$e_{ini} = N_{max}$$

$$e_{plus} = a \times N_{max}$$

$$e_{minus} = a \times \left| \Delta N_i^b \right|$$

The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting puncturing when the algorithm of subclause 4.2.7.5 is run. The resulting values of $\Delta N_{i,l}^{TTI}$ can be represented with following expression.

$$\Delta N_{i,l}^{TTI} = -\left\lfloor \frac{\left|\Delta N_i^2\right| \times X_i}{N_{max}} + 0.5 \right\rfloor - \left\lfloor \frac{\left|\Delta N_i^3\right| \times X_i}{N_{max}} \right\rfloor$$

In the above equation, the first term of the right hand side represents the amount of puncturing for b=2 and the second term represents the amount of puncturing for b=3.

4.2.7.2.2 Determination of rate matching parameters for flexible positions of TrCHs

4.2.7.2.2.1 Calculations for normal mode, compressed mode by higher layer scheduling, and compressed mode by spreading factor reduction

First an intermediate calculation variable N_{ij} is calculated for all transport channels *i* and all transport format combinations *j* by the following formula:

$$N_{i,j} = \frac{1}{F_i} \times N_{i,TF_i(j)}^{TTI}$$

Then rate matching ratios RF_i are calculated for each the transport channel *i* in order to minimise the number of DTX bits when the bit rate of the CCTrCH is maximum. The RF_i ratios are defined by the following formula:

$$RF_i = \frac{N_{data,*}}{\max\limits_{j \in TFCS} \sum_{i=1}^{i=I} \left(RM_i \times N_{i,j}\right)} \times RM_i$$

The computation of $\Delta N_{i,l}^{TTI}$ parameters is then performed in two phases. In a first phase, tentative temporary values of $\Delta N_{i,l}^{TTI}$ are computed, and in the second phase they are checked and corrected. The first phase, by use of the RF_i ratios, ensures that the number of DTX indication bits inserted is minimum when the CCTrCH bit rate is maximum, but it does not ensure that the maximum CCTrCH bit rate is not greater than $N_{data,*}$ per 10ms. The latter condition is ensured through the checking and possible corrections carried out in the second phase.

At the end of the second phase, the latest value of $\Delta N_{i,l}^{TTI}$ is the definitive value.

The first phase defines the tentative temporary $\Delta N_{i,l}^{TTI}$ for all transport channel *i* and any of its transport format *l* by use of the following formula:

$$\Delta N_{i,l}^{TTI} = F_i \times \left\lceil \frac{RF_i \times N_{i,l}^{TTI}}{F_i} \right\rceil - N_{i,l}^{TTI} = F_i \times \left\lceil \frac{N_{data,*} \times RM_i \times N_{i,l}^{TTI}}{F_i \times \max\limits_{j \in TFCS} \sum\limits_{i=1}^{I} \left(RM_i \times N_{i,j} \right)} \right\rceil - N_{i,l}^{TTI}$$

The second phase is defined by the following algorithm:

for all j in $TFCS$ in ascending order of TFCI do — for all TFC

$$D = \sum_{i=1}^{i=I} \frac{N_{i,TF_i(j)}^{TTI} + \Delta N_{i,TF_i(j)}^{TTI}}{F_i}$$ — CCTrCH bit rate (bits per 10ms) for TFC j

if $D > N_{data,*}$ then

for $i = 1$ to I do — for all TrCH

$\Delta N = F_i \times \Delta N_{i,j}$ — $\Delta N_{i,j}$ is derived from $N_{i,j}$ by the formula given at subclause 4.2.7.

if $\Delta N_{i,TF_i(j)}^{TTI} > \Delta N$ then

$\Delta N_{i,TF_i(j)}^{TTI} = \Delta N$

end-if

end-for

end-if

end-for

If $\Delta N_{i,l}^{TTI} = 0$ then, for TrCH i at TF l, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed.

If $\Delta N_{i,l}^{TTI} \neq 0$ the parameters listed in subclauses 4.2.7.2.2.2 and 4.2.7.2.2.3 shall be used for determining e_{ini}, e_{plus}, and e_{minus}.

4.2.7.2.2.2 Determination of rate matching parameters for convolutionally encoded TrCHs

$\Delta N_i = \Delta N_{il}^{TTI}$

$a=2$

For each transmission time interval of TrCH i with TF l, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5. The following parameters are used as input:

$X_i = N_{il}^{TTI}$

$e_{ini} = 1$

$e_{plus} = a \times N_{il}^{TTI}$

$e_{minus} = a \times |\Delta N_i|$

puncturing for $\Delta N_i < 0$, repetition otherwise.

4.2.7.2.2.3 Determination of rate matching parameters for Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{il}^{TTI} > 0$, the parameters in subclause 4.2.7.2.2.2 are used.

If puncturing is to be performed, the parameters below shall be used. Index b is used to indicate systematic (b=1), 1[st] parity (b=2), and 2[nd] parity bit (b=3).

a=2 when b=2

a=1 when b=3

The bits indicated by b=1 shall not be punctured.

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{il}^{TTI} / 2 \rfloor, & b = 2 \\ \lceil \Delta N_{il}^{TTI} / 2 \rceil, & b = 3 \end{cases}$$

For each transmission time interval of TrCH i with TF l, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5. The following parameters are used as input:

$X_i = N_{il}^{TTI} / 3$,

$e_{ini} = X_i$,

$e_{plus} = a \times X_i$

$e_{minus} = a \times |\Delta N_i|$

4.2.7.3 Bit separation and collection in uplink

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences.

The first sequence contains:

- All of the systematic bits that are from turbo encoded TrCHs.
- From 0 to 2 first and/or second parity bits that are from turbo encoded TrCHs. These bits come into the first sequence when the total number of bits in a block after radio frame segmentation is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second sequence contains:

- All of the first parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The third sequence contains:

- All of the second parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second and third sequences shall be of equal length, whereas the first sequence can contain from 0 to 2 more bits. Puncturing is applied only to the second and third sequences.The bit separation function is transparent for convolutionally encoded TrCHs and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 5 and 6.

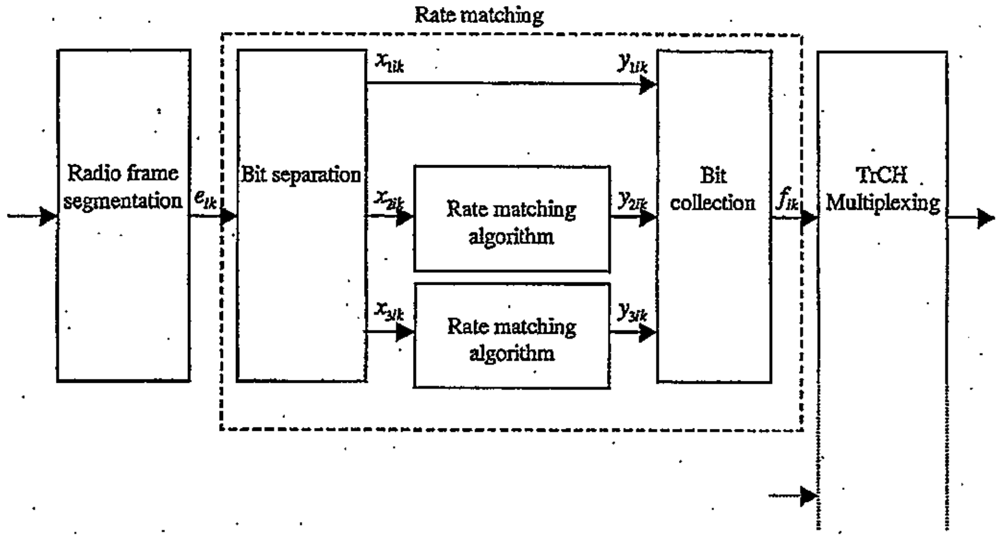


Figure 5: Puncturing of turbo encoded TrCHs in uplink

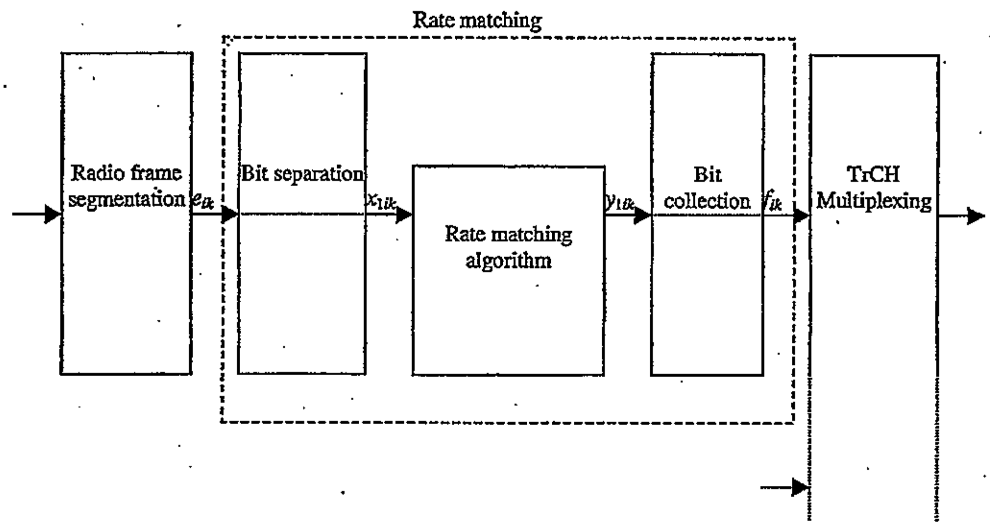


Figure 6: Rate matching for convolutionally encoded TrCHs and for turbo encoded TrCHs with repetition in uplink

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. b indicates the three sequences defined in this section, with b=1 indicating the first sequence, b = 2 the second one, and b = 3 the third one. The offsets α_b for these sequences are listed in table 5.

Table 5: TTI dependent offset needed for bit separation

TTI (ms)	α_1	α_2	α_3
10, 40	0	1	2
20, 80	0	2	1

The bit separation is different for different radio frames in the TTI. A second offset is therefore needed. The radio frame number for TrCH i is denoted by n_i. and the offset by β_{n_i}.

Table 6: Radio frame dependent offset needed for bit separation

TTI (ms)	β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7
10	0	NA	NA	NA	NA	NA	NA	NA
20	0	1	NA	NA	NA	NA	NA	NA
40	0	1	2	0	NA	NA	NA	NA
80	0	1	2	0	1	2	0	1

4.2.7.3.1 Bit separation

The bits input to the rate matching are denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where i is the TrCH number and N_i is the number of bits input to the rate matching block. Note that the transport format combination number j for simplicity has been left out in the bit numbering, i.e. N_i=N_{ij}. The bits after separation are denoted by $x_{bi1}, x_{bi2}, x_{bi3}, \ldots, x_{biX_i}$. For turbo encoded TrCHs with puncturing, b indicates the three sequences defined in section 4.2.7.3, with b=1 indicating the first sequence, and so forth. For all other cases b is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between e_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = e_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

$x_{1,i,\lfloor N_i/3 \rfloor + k} = e_{i,3\lfloor N_i/3 \rfloor + k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When (N_i mod 3) = 0 this row is not needed.

$x_{2,i,k} = e_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

For convolutionally encoded TrCHs and turbo encoded TrCHs with repetition:

$x_{1,i,k} = e_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = N_i$

4.2.7.3.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in subclause 4.2.7.5. The bits output from the rate matching algorithm are denoted $y_{bi1}, y_{bi2}, y_{bi3}, \ldots, y_{biY_i}$.

Bit collection is the inverse function of the separation. The bits after collection are denoted by $z_{bi1}, z_{bi2}, z_{bi3}, \ldots, z_{biY_i}$. After bit collection, the bits indicated as punctured are removed and the bits are then denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where i is the TrCH number and V_i= N_{ij}+ΔN_{ij}. The relations between y_{bik}, z_{bik} and f_{ik} are given below.

For turbo encoded TrCHs with puncturing (Y_i=X_i):

$z_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3\lfloor N_i/3 \rfloor + k} = y_{1,i,\lfloor N_i/3 \rfloor + k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When (N_i mod 3) = 0 this row is not needed.

$z_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3} = y_{2,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3} = y_{3,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index k after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index k after puncturing, and so on.

For convolutionally encoded TrCHs and turbo encoded TrCHs with repetition:

$$z_{i,k} = y_{1,i,k} \qquad k = 1, 2, 3, \ldots, Y_i$$

When repetition is used, $f_{i,k}=z_{i,k}$ and $Y_i=V_i$.

When puncturing is used, $Y_i=X_i$ and bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index k after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index k after puncturing, and so on.

4.2.7.4 Bit separation and collection in downlink

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits may be punctured.

The systematic bits, first parity bits and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences of equal lengths.

The first sequence contains :

- All of the systematic bits that are from turbo encoded TrCHs.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second sequence contains:

- All of the first parity bits that are from turbo encoded TrCHs.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The third sequence contains:

- All of the second parity bits that are from turbo encoded TrCHs.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

Puncturing is applied only to the second and third sequences.

The bit separation function is transparent for convolutionally encoded TrCHs and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 7 and 8.

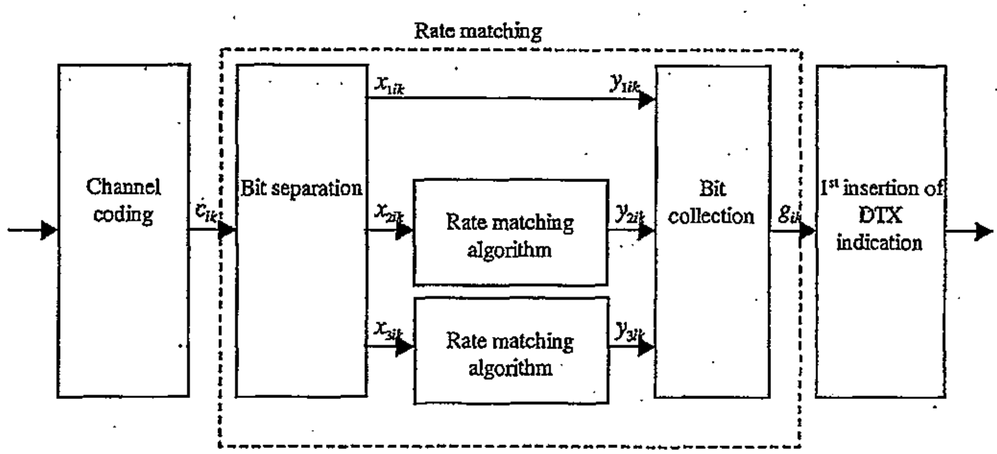


Figure 7: Puncturing of turbo encoded TrCHs in downlink

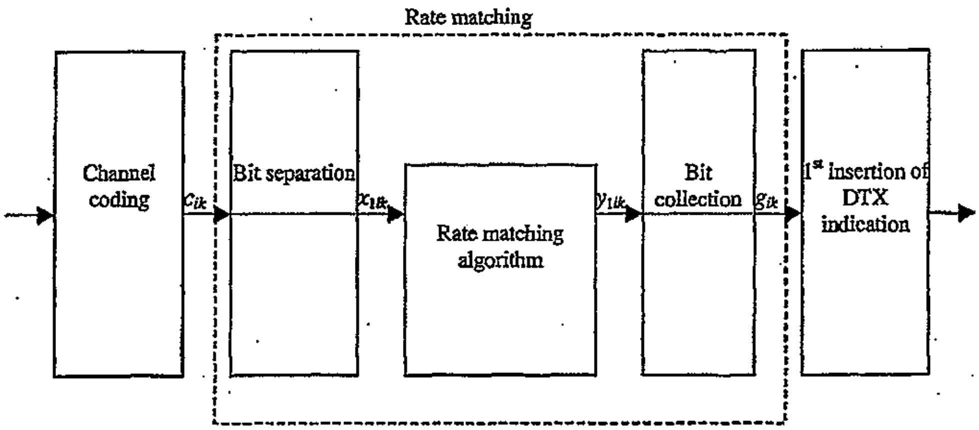


Figure 8: Rate matching for convolutionally encoded TrCHs and for turbo encoded TrCHs with repetition in downlink

4.2.7.4.1 Bit separation

The bits input to the rate matching are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is the TrCH number and E_i is the number of bits input to the rate matching block. Note that E_i is a multiple of 3 for turbo encoded TrCHs and that the transport format l for simplicity has been left out in the bit numbering, i.e. $E_i = N_{il}^{TTI}$. The bits after separation are denoted by $x_{bi1}, x_{bi2}, x_{bi3}, \ldots, x_{biX_i}$. For turbo encoded TrCHs with puncturing, b indicates the three sequences defined in section 4.2.7.4, with b=1 indicating the first sequence, and so forth. For all other cases b is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between c_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = c_{i,3(k-1)+1}$ $\quad k = 1, 2, 3, \ldots, X_i \quad X_i = E_i / 3$

$x_{2,i,k} = c_{i,3(k-1)+2}$ $\quad k = 1, 2, 3, \ldots, X_i \quad X_i = E_i / 3$

$x_{3,i,k} = c_{i,3(k-1)+3}$ $\quad k = 1, 2, 3, \ldots, X_i \quad X_i = E_i / 3$

For convolutionally encoded TrCHs and turbo encoded TrCHs with repetition:

$x_{1,i,k} = c_{i,k}$ $\quad k = 1, 2, 3, \ldots, X_i \quad X_i = E_i$

4.2.7.4.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in subclause 4.2.7.5. The bits output from the rate matching algorithm are denoted $y_{bi1}, y_{bi2}, y_{bi3}, \ldots, y_{biY_i}$.

Bit collection is the inverse function of the separation. The bits after collection are denoted by $z_{bi1}, z_{bi2}, z_{bi3}, \ldots, z_{biY_i}$. After bit collection, the bits indicated as punctured are removed and the bits are then denoted by $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where i is the TrCH number and $G_i = N_{il}^{TTI} + \Delta N_{il}^{TTI}$. The relations between y_{bik}, z_{bik}, and g_{ik} are given below.

For turbo encoded TrCHs with puncturing (Y_i=X_i):

$z_{i,3(k-1)+1} = y_{1,i,k}$ $\quad k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+2} = y_{2,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+3} = y_{3,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $g_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index k after puncturing, bit $g_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index k after puncturing, and so on.

For convolutionally encoded TrCHs and turbo encoded TrCHs with repetition:

$z_{i,k} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

When repetition is used, $g_{i,k}=z_{i,k}$ and $Y_i=G_i$.

When puncturing is used, $Y_i=X_i$ and bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $g_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index k after puncturing, bit $g_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index k after puncturing, and so on.

4.2.7.5 Rate matching pattern determination

Denote the bits before rate matching by:

$x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where i is the TrCH number and the sequence is defined in 4.2.7.3 for uplink or in 4.2.7.4 for downlink. Parameters X_i, e_{ini}, e_{plus}, and e_{minus} are given in 4.2.7.1 for uplink or in 4.2.7.2 for downlink.

The rate matching rule is as follows:

```
if puncturing is to be performed
    e = e_ini        -- initial error between current and desired puncturing ratio
    m = 1            -- index of current bit
    do while m <= X_i
        e = e – e_minus        -- update error
        if e <= 0 then         -- check if bit number m should be punctured
            set bit x_i,m to δ where δ∉{0, 1}
            e = e + e_plus     -- update error
        end if
        m = m + 1              -- next bit
    end do
else
    e = e_ini        -- initial error between current and desired puncturing ratio
    m = 1            -- index of current bit
    do while m <= X_i
        e = e – e_minus        -- update error
        do while e <= 0        -- check if bit number m should be repeated
            repeat bit x_i,m
            e = e + e_plus -- update error
```

end do

$m = m + 1$ -- *next bit*

end do

end if

A repeated bit is placed directly after the original one.

4.2.8 TrCH multiplexing

Every 10 ms, one radio frame from each TrCH is delivered to the TrCH multiplexing. These radio frames are serially multiplexed into a coded composite transport channel (CCTrCH).

The bits input to the TrCH multiplexing are denoted by $f_{i1}, f_{i2}, f_{i3}, \dots, f_{iV_i}$, where i is the TrCH number and V_i is the number of bits in the radio frame of TrCH i. The number of TrCHs is denoted by I. The bits output from TrCH multiplexing are denoted by $s_1, s_2, s_3, \dots, s_S$, where S is the number of bits, i.e. $S = \sum_i V_i$. The TrCH multiplexing is defined by the following relations:

$$s_k = f_{1k} \quad k = 1, 2, \dots, V_1$$

$$s_k = f_{2,(k-V_1)} \quad k = V_1+1, V_1+2, \dots, V_1+V_2$$

$$s_k = f_{3,(k-(V_1+V_2))} \quad k = (V_1+V_2)+1, (V_1+V_2)+2, \dots, (V_1+V_2)+V_3$$

...

$$s_k = f_{I,(k-(V_1+V_2+\dots+V_{I-1}))} \quad k = (V_1+V_2+\dots+V_{I-1})+1, (V_1+V_2+\dots+V_{I-1})+2, \dots, (V_1+V_2+\dots+V_{I-1})+V_I$$

4.2.9 Insertion of discontinuous transmission (DTX) indication bits

In the downlink, DTX is used to fill up the radio frame with bits. The insertion point of DTX indication bits depends on whether fixed or flexible positions of the TrCHs in the radio frame are used. It is up to the UTRAN to decide for each CCTrCH whether fixed or flexible positions are used during the connection. DTX indication bits only indicate when the transmission should be turned off, they are not transmitted.

4.2.9.1 1st insertion of DTX indication bits

This step of inserting DTX indication bits is used only if the positions of the TrCHs in the radio frame are fixed. With fixed position scheme a fixed number of bits is reserved for each TrCH in the radio frame.

The bits from rate matching are denoted by $g_{i1}, g_{i2}, g_{i3}, \dots, g_{iG_i}$, where G_i is the number of bits in one TTI of TrCH i. Denote the number of bits in one radio frame of TrCH i by H_i. Denote D_i the number of bits output of the first DTX insertion block.

In TTIs containing no compressed frames or frames compressed by spreading factor reduction, H_i is constant and corresponds to the maximum number of bits from TrCH i in one radio frame for any transport format of TrCH i and $D_i = F_i \times H_i$.

The bits output from the DTX insertion are denoted by $h_{i1}, h_{i2}, h_{i3}, \dots, h_{iDi}$ Note that these bits are three valued. They are defined by the following relations:

$$h_{ik} = g_{ik} \quad k = 1, 2, 3, \dots, G_i$$

$$h_{ik} = \delta \quad k = G_i+1, G_i+2, G_i+3, \dots, D_i$$

where DTX indication bits are denoted by δ. Here $g_{ik} \in \{0, 1\}$ and $\delta \notin \{0, 1\}$.

4.2.9.2 2nd insertion of DTX indication bits

The DTX indication bits inserted in this step shall be placed at the end of the radio frame. Note that the DTX will be distributed over all slots after 2nd interleaving.

The bits input to the DTX insertion block are denoted by $s_1, s_2, s_3, \ldots, s_S$, where S is the number of bits from TrCH multiplexing. The number of PhCHs is denoted by P and the number of bits in one radio frame, including DTX indication bits, for each PhCH by R..

In non-compressed frames, $R = \frac{N_{data,*}}{P} = 15 \times (N_{data1} + N_{data2})$, where N_{data1} and N_{data2} are defined in [2].

For compressed frames, $N'_{data,*}$ is defined as $N'_{data,*} = P \times 15 \times (N'_{data1} + N'_{data2})$. N'_{data1} and N'_{data2} are the number of bits in the data fields of the slot format used for the current compressed frame, i.e. slot format A or B as defined in [2] corresponding to the spreading factor and the number of transmitted slots in use.

In frames compressed by higher layer scheduling, additional DTX with respect to normal mode shall be inserted if the transmission time reduction does not exactly create a transmission gap of the desired *TGL*.

The number of bits available to the CCTrCH in one radio frame compressed by spreading factor reduction or by higher layer scheduling is denoted by $N_{data,*}^{cm}$ and $R = \frac{N_{data,*}^{cm}}{P}$.

For frames compressed by spreading factor reduction $N_{data,*}^{cm} = \frac{N'_{data,*}}{2}$.

For frames compressed by higher layer scheduling the exact value of $N_{data,*}^{cm}$ is dependent on the *TGL* which is signalled from higher layers. It can be calculated as $N_{data,*}^{cm} = N'_{data,*} - N_{TGL}$.

N_{TGL} is the number of bits that are located within the transmission gap and defined as:

$$N_{TGL} = \begin{cases} \frac{TGL}{15} \times N'_{data,*}, & \text{if } N_{first} + TGL \leq 15 \\ \frac{15 - N_{first}}{15} \times N'_{data,*}, & \text{in first frame if } N_{first} + TGL > 15 \\ \frac{TGL - (15 - N_{first})}{15} \times N'_{data,*}, & \text{in second frame if } N_{first} + TGL > 15 \end{cases}$$

N_{first} and *TGL* are defined in subclause 4.4.

The bits output from the DTX insertion block are denoted by $w_1, w_2, w_3, \ldots, w_{(PR)}$. Note that these bits are three valued. They are defined by the following relations:

$w_k = s_k$ k = 1, 2, 3, ..., S

$w_k = \delta$ k = S+1, S+2, S+3, ..., $P \cdot R$

where DTX indication bits are denoted by δ. Here $s_k \in \{0,1, p\}$ and $\delta \notin \{0,1\}$.

4.2.10 Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $x_1, x_2, x_3, \ldots, x_X$, where X is the number of bits input to the physical channel segmentation block. The number of PhCHs is denoted by P.

The bits after physical channel segmentation are denoted $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U}$, where p is PhCH number and U is the number of bits in one radio frame for each PhCH, i.e. $U = \frac{X}{P}$. The relation between x_k and $u_{p,k}$ is given below.

For all modes, some bits of the input flow are mapped to each code until the number of bits on the code is U. All bits of the input flow are taken to be mapped to the codes.Bits on first PhCH after physical channel segmentation:

$$u_{1,k} = x_k \quad k = 1, 2, \ldots, U$$

Bits on second PhCH after physical channel segmentation:

$$u_{2,k} = x_{k+U} \quad k = 1, 2, \ldots, U$$

...

Bits on the P^{th} PhCH after physical channel segmentation:

$$u_{P,k} = x_{k+(P-1)\times U} \quad k = 1, 2, \ldots, U$$

4.2.10.1 Relation between input and output of the physical segmentation block in uplink

The bits input to the physical segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$. Hence, $x_k = s_k$ and $Y = S$.

4.2.10.2 Relation between input and output of the physical segmentation block in downlink

The bits input to the physical segmentation are denoted by $w_1, w_2, w_3, \ldots, w_{(PU)}$. Hence, $x_k = w_k$ and $Y = PU$.

4.2.11 2nd interleaving

The 2nd interleaving is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix with pruning. The bits input to the block interleaver are denoted by $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U}$, where p is PhCH number and U is the number of bits in one radio frame for one PhCH. The output bit sequence from the block interleaver is derived as follows:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, ..., C2 - 1 from left to right.

(2) Determine the number of rows of the matrix, R2, by finding minimum integer R2 such that:

$U \leq \text{R2} \times \text{C2}$.

The rows of rectangular matrix are numbered 0, 1, 2, ..., R2 - 1 from top to bottom.

(3) Write the input bit sequence $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U}$ into the R2 × C2 matrix row by row starting with bit $y_{p,1}$ in column 0 of row 0:

$$\begin{bmatrix} y_{p,1} & y_{p,2} & y_{p,3} & \cdots & y_{p,C2} \\ y_{p,(C2+1)} & y_{p,(C2+2)} & y_{p,(C2+3)} & \cdots & y_{p,(2\times C2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{p,((R2-1)\times C2+1)} & y_{p,((R2-1)\times C2+2)} & y_{p,((R2-1)\times C2+3)} & \cdots & y_{p,(R2\times C2)} \end{bmatrix}$$

where $y_{p,k} = u_{p,k}$ for $k = 1, 2, \ldots, U$ and if $R2 \times C2 > U$, the dummy bits are padded such that $y_{p,k} = 0$ or 1 for $k = U+1, U+2, \ldots, R2 \times C2$. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle P2(j) \rangle_{j \in \{0,1,\ldots,C2-1\}}$ that is shown in table 7, where $P2(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by $y'_{p,k}$.

$$\begin{bmatrix} y'_{p,1} & y'_{p,(R2+1)} & y'_{p,(2\times R2+1)} & \cdots & y'_{p,((C2-1)\times R2+1)} \\ y'_{p,2} & y'_{p,(R2+2)} & y'_{p,(2\times R2+2)} & \cdots & y'_{p,((C2-1)\times R2+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y'_{p,R2} & y'_{p,(2\times R2)} & y'_{p,(3\times R2)} & \cdots & y'_{p,(C2\times R2)} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted $R2 \times C2$ matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_{p,k}$ that corresponds to bits $y_{p,k}$ with $k>U$ are removed from the output. The bits after 2nd interleaving are denoted by $v_{p,1}, v_{p,2}, \ldots, v_{p,U}$, where $v_{p,1}$ corresponds to the bit $y'_{p,k}$ with smallest index k after pruning, $v_{p,2}$ to the bit $y'_{p,k}$ with second smallest index k after pruning, and so on.

Table 7 Inter-column permutation pattern for 2nd interleaving

Number of columns C2	Inter-column permutation pattern < P2(0), P2(1), …, P2(C2-1) >
30	<0, 20, 10, 5, 15, 25, 3, 13, 23, 8, 18, 28, 1, 11, 21, 6, 16, 26, 4, 14, 24, 19, 9, 29, 12, 2, 7, 22, 27, 17>

4.2.12 Physical channel mapping

The PhCH for both uplink and downlink is defined in [2]. The bits input to the physical channel mapping are denoted by $v_{p,1}, v_{p,2}, \ldots, v_{p,U}$, where p is the PhCH number and U is the number of bits in one radio frame for one PhCH. The bits $v_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

In compressed mode, no bits are mapped to certain slots of the PhCH(s). If $N_{first} + TGL \le 15$, no bits are mapped to slots N_{first} to N_{last}. If $N_{first} + TGL > 15$, i.e. the transmission gap spans two consecutive radio frames, the mapping is as follows:

- In the first radio frame, no bits are mapped to slots N_{first}, $N_{first}+1$, $N_{first}+2$, …, 14.
- In the second radio frame, no bits are mapped to the slots 0, 1, 2, …, N_{last}.

TGL, N_{first}, and N_{last} are defined in subclause 4.4.

4.2.12.1 Uplink

In uplink, the PhCHs used during a radio frame are either completely filled with bits that are transmitted over the air or not used at all. The only exception is when the UE is in compressed mode. The transmission can then be turned off during consecutive slots of the radio frame.

4.2.12.2 Downlink

In downlink, the PhCHs do not need to be completely filled with bits that are transmitted over the air. Values $v_{p,k} \notin \{0, 1\}$ correspond to DTX indicators, which are mapped to the DPCCH/DPDCH fields but are not transmitted over the air.

During compressed mode by reducing the spreading factor by 2, the data bits are always mapped into 7.5 slots within a compressed frame. No bits are mapped to the DPDCH field as follows:

If $N_{first} + TGL \leq 15$, i.e. the transmission gap spans one radio frame,

if $N_{first} + 7 \leq 14$

no bits are mapped to slots $N_{first}, N_{first} + 1, N_{first} + 2, \ldots, N_{first} + 6$

no bits are mapped to the first $(N_{Data1} + N_{Data2})/2$ bit positions of slot $N_{first}+7$

else

no bits are mapped to slots $N_{first}, N_{first} + 1, N_{first} + 2, \ldots, 14$

no bits are mapped to slots $N_{first} - 1, N_{first} - 2, N_{first} - 3, \ldots, 8$

no bits are mapped to the last $(N_{Data1} + N_{Data2})/2$ bit positions of slot 7

end if

If $N_{first} + TGL > 15$, i.e. the transmission gap spans two consecutive radio frames,

In the first radio frame, no bits are mapped to last $(N_{Data1} + N_{Data2})/2$ bit positions in slot 7 as well as to slots 8, 9, 10, ..., 14.

In the second radio frame, no bits are mapped to slots 0, 1, 2, ..., 6 as well as to first $(N_{Data1} + N_{Data2})/2$ bit positions in slot 7.

N_{Data1} and N_{Data2} are defined in [2].

4.2.13 Restrictions on different types of CCTrCHs

Restrictions on the different types of CCTrCHs are described in general terms in TS 25.302[11]. In this subclause those restrictions are given with layer 1 notation.

4.2.13.1 Uplink Dedicated channel (DCH)

The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_i on each transport channel, and the maximum value of the number of DPDCHs P are given from the UE capability class.

4.2.13.2 Random Access Channel (RACH)

- There can only be one TrCH in each RACH CCTrCH, i.e. I=1, $s_k = f_{1k}$ and $S = V_1$.
- The maximum value of the number of transport blocks M_1 on the transport channel is given from the UE capability class.
- The transmission time interval is either 10 ms or 20 ms.
- Only one PRACH is used, i.e. P=1, $u_{1k} = s_k$, and $U = S$.

- The Static rate matching parameter RM_1 is not provided by higher layer signalling on the System information as the other transport channel parameters. Any value may be used as there is one transport channel in the CCTrCH, hence one transport channel per Transport Format Combination and no need to do any balancing between multiple transport channels.

4.2.13.3 Void

4.2.13.4 Downlink Dedicated Channel (DCH)

The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_i on each transport channel, and the maximum value of the number of DPDCHs P are given from the UE capability class.

4.2.13.5 Void

4.2.13.6 Broadcast channel (BCH)

- There can only be one TrCH in the BCH CCTrCH, i.e. I=1, $s_k = f_{1k}$, and $S = V_1$.
- There can only be one transport block in each transmission time interval, i.e. $M_1 = 1$.
- All transport format attributes have predefined values which are provided in [11] apart from the rate matching RM_1.
- The Static rate matching parameter RM_1 is not provided by higher layer signalling neither fixed. Any value may be used as there is one transport channel in the CCTrCH, hence one transport channel per Transport Format Combination and no need to do any balancing between multiple transport channels.
- Only one primary CCPCH is used, i.e. P=1.

4.2.13.7 Forward access and paging channels (FACH and PCH)

- The maximum value of the number of TrCHs I in a CCTrCH and the maximum value of the number of transport blocks M_i on each transport channel are given from the UE capability class.
- The transmission time interval for TrCHs of PCH type is always 10 ms.
- Only one secondary CCPCH is used per CCTrCH, i.e. P=1.

4.2.13.8 High Speed Downlink Shared Channel (HS-DSCH) associated with a DCH

- There can be only one TrCH in the HS-DSCH CCTrCH, i.e. I = 1,
- There can only be one transport block in each transmission time interval, i.e. $M_1 = 1$.
- The transmission time interval for TrCHs of HS-DSCH type is always 2 ms.
- The maximum value of the number of HS-PDSCHs P are given from the UE capability class.

4.2.14 Multiplexing of different transport channels into one CCTrCH, and mapping of one CCTrCH onto physical channels

The following rules shall apply to the different transport channels which are part of the same CCTrCH:

1) Transport channels multiplexed into one CCTrCh shall have co-ordinated timings. When the TFCS of a CCTrCH is changed because one or more transport channels are added to the CCTrCH or reconfigured within the CCTrCH, or removed from the CCTrCH, the change may only be made at the start of a radio frame with CFN fulfilling the relation

   CFN mod $F_{max} = 0$,

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH, including any transport channels *i* which are added, reconfigured or have been removed, and CFN denotes the connection frame number of the first radio frame of the changed CCTrCH.

After addition or reconfiguration of a transport channel *i* within a CCTrCH, the TTI of transport channel *i* may only start in radio frames with CFN fulfilling the relation:

CFN mod $F_i = 0$.

2) Only transport channels with the same active set can be mapped onto the same CCTrCH.

3) Different CCTrCHs cannot be mapped onto the same PhCH.

4) One CCTrCH shall be mapped onto one or several PhCHs. These physical channels shall all have the same SF.

5) Dedicated Transport channels and common transport channels cannot be multiplexed into the same CCTrCH.

6) For the common transport channels, only the FACH and PCH may belong to the same CCTrCH.

There are hence two types of CCTrCH:

1) CCTrCH of dedicated type, corresponding to the result of coding and multiplexing of one or several DCHs.

2) CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, RACH in the uplink, HS-DSCH, BCH, or FACH/PCH for the downlink.

4.2.14.1 Allowed CCTrCH combinations for one UE

4.2.14.1.1 Allowed CCTrCH combinations on the uplink

A maximum of one CCTrCH is allowed for one UE on the uplink. It can be either:

1) one CCTrCH of dedicated type;

2) one CCTrCH of common type.

4.2.14.1.2 Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed:

- x CCTrCH of dedicated type + y CCTrCH of common type. The allowed combination of CCTrCHs of dedicated and common type are given from UE radio access capabilities. There can be a maximum of one CCTrCH of common type for HS-DSCH and a maximum of one CCTrCH of common type for FACH. With one CCTrCH of common type for HS-DSCH, there shall be only one CCTrCH of dedicated type.

NOTE 1: There is only one DPCCH in the uplink, hence one TPC bits flow on the uplink to control possibly the different DPDCHs on the downlink, part of the same or several CCTrCHs.

NOTE 2: There is only one DPCCH in the downlink, even with multiple CCTrCHs. With multiple CCTrCHs, the DPCCH is transmitted on one of the physical channels of that CCTrCH which has the smallest SF among the multiple CCTrCHs. Thus there is only one TPC command flow and only one TFCI word in downlink even with multiple CCTrCHs.

NOTE 3: in the current release, only 1 CCTrCH of dedicated type is supported.

4.3 Transport format detection

If the transport format set of a TrCH *i* contains more than one transport format, the transport format can be detected according to one of the following methods:

- TFCI based detection: This method is applicable when the transport format combination is signalled using the TFCI field;

- explicit blind detection: This method typically consists of detecting the TF of TrCH *i* by use of channel decoding and CRC check;
- guided detection: This method is applicable when there is at least one other TrCH *i'*, hereafter called guiding TrCH, such that:
  - the guiding TrCH has the same TTI duration as the TrCH under consideration, i.e. $F_{i'} = F_i$;
  - different TFs of the TrCH under consideration correspond to different TFs of the guiding TrCH;
  - explicit blind detection is used on the guiding TrCH.

If the transport format set for a TrCH *i* does not contain more than one transport format with more than zero transport blocks, no explicit blind transport format detection needs to be performed for this TrCH. The UE can use guided detection for this TrCH or single transport format detection, where the UE always assumes the transport format corresponding to more than zero transport blocks for decoding.

For uplink, blind transport format detection is a network controlled option. For downlink, the UE shall be capable of performing blind transport format detection, if certain restrictions on the configured transport channels are fulfilled.

4.3.1 Blind transport format detection

When no TFCI is available then explicit blind detection or guided detection shall be performed on all TrCHs within the CCTrCH that have more than one transport format and that do not use single transport format detection. The UE shall only be required to support blind transport format detection if all of the following restrictions are fulfilled:

1. either only one CCTrCH is received, or one CCTrCH of dedicated type and one CCTrCH of common type for HS-DSCH are received by the UE;

   If only one CCTrCH is received by the UE, the following conditions apply to that CCTrCH and those TrCHs that are multiplexed on the CCTrCH. If one CCTrCH of dedicated type and one CCTrCH of common type for HS-DSCH are received by the UE, the following conditions apply to the dedicated type CCTrCH and the TrCHs that are multiplexed on the dedicated type CCTrCH.

2. the number of CCTrCH bits received per radio frame is 600 or less;
3. the number of transport format combinations of the CCTrCH is 64 or less;
4. fixed positions of the transport channels is used on the CCTrCH to be detectable;
5. convolutional coding is used on all explicitly detectable TrCHs;
6. CRC with non-zero length is appended to all transport blocks on all explicitly detectable TrCHs;
7. at least one transport block shall be transmitted per TTI on each explicitly detectable TrCH;
8. the number of explicitly detectable TrCHs is 3 or less;
9. for all explicitly detectable TrCHs *i*, the number of code blocks in one TTI (C_i) shall not exceed 1;
10. the sum of the transport format set sizes of all explicitly detectable TrCHs, is 16 or less. The transport format set size is defined as the number of transport formats within the transport format set;
11. there is at least one TrCH that can be used as the guiding transport channel for all transport channels using guided detection.

Examples of blind transport format detection methods are given in annex A.

4.3.1a Single transport format detection

When no TFCI is available, then single transport format detection shall be applied on all TrCHs within the CCTrCH that have a transport format set not containing more than one transport format with more than zero transport blocks and that do not use guided detection. The UE shall only be required to support single transport format detection if the following restrictions are fulfilled:

1. For each transport channel that is single transport format detected, CRC with non-zero length is appended to all transport blocks within the non-zero transport block transport format;

2. fixed positions of the transport channels is used on the CCTrCH to be detectable.

4.3.2 Transport format detection based on TFCI

If a TFCI is available, then TFCI based detection shall be applicable to all TrCHs within the CCTrCH. The TFCI informs the receiver about the transport format combination of the CCTrCHs. As soon as the TFCI is detected, the transport format combination, and hence the transport formats of the individual transport channels are known.

4.3.3 Coding of Transport-Format-Combination Indicator (TFCI)

The TFCI is encoded using a (32, 10) sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 9.

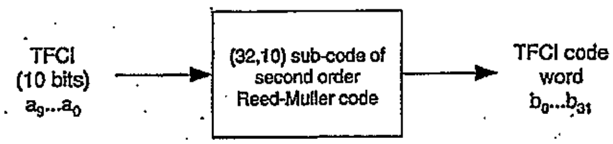


Figure 9: Channel coding of TFCI information bits

If the TFCI consist of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. The length of the TFCI code word is 32 bits.

The code words of the (32,10) sub-code of second order Reed-Muller code are linear combination of 10 basis sequences. The basis sequences are as in the following table 8.

Table 8: Basis sequences for (32,10) TFCI code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$	$M_{i,5}$	$M_{i,6}$	$M_{i,7}$	$M_{i,8}$	$M_{i,9}$
0	1	0	0	0	0	1	0	0	0	0
1	0	1	0	0	0	1	1	0	0	0
2	1	1	0	0	0	1	0	0	0	1
3	0	0	1	0	0	1	1	0	1	1
4	1	0	1	0	0	1	0	0	0	1
5	0	1	1	0	0	1	0	0	1	0
6	1	1	1	0	0	1	0	1	0	0
7	0	0	0	1	0	1	0	1	1	0
8	1	0	0	1	0	1	1	1	1	0
9	0	1	0	1	0	1	1	0	1	1
10	1	1	0	1	0	1	0	0	1	1
11	0	0	1	1	0	1	0	1	1	0
12	1	0	1	1	0	1	0	1	0	1
13	0	1	1	1	0	1	1	0	0	1
14	1	1	1	1	0	1	1	1	1	1
15	1	0	0	0	1	1	1	1	0	0
16	0	1	0	0	1	1	1	1	0	1
17	1	1	0	0	1	1	1	0	1	0
18	0	0	1	0	1	1	0	1	1	1
19	1	0	1	0	1	1	0	1	0	1
20	0	1	1	0	1	1	0	0	1	1
21	1	1	1	0	1	1	0	1	1	1
22	0	0	0	1	1	1	0	1	0	0
23	1	0	0	1	1	1	1	1	0	1
24	0	1	0	1	1	1	1	0	1	0
25	1	1	0	1	1	1	1	0	0	1
26	0	0	1	1	1	1	0	0	1	0
27	1	0	1	1	1	1	1	1	0	0
28	0	1	1	1	1	1	1	1	1	0
29	1	1	1	1	1	1	1	1	1	1
30	0	0	0	0	0	1	0	0	0	0
31	0	0	0	0	1	1	1	0	0	0

The TFCI information bits $a_0, a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9$ (where a_0 is LSB and a_9 is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output code word bits b_i are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where $i = 0, \ldots, 31$.

The output bits are denoted by b_k, $k = 0, 1, 2, \ldots, 31$.

In downlink, when the SF < 128 the encoded TFCI code words are repeated yielding 8 encoded TFCI bits per slot in normal mode and 16 encoded TFCI bits per slot in compressed mode. Mapping of repeated bits to slots is explained in subclause 4.3.5.

4.3.4 Void

4.3.5 Mapping of TFCI words

4.3.5.1 Mapping of TFCI word in normal mode

The bits of the code word are directly mapped to the slots of the radio frame. Within a slot the bit with lower index is transmitted before the bit with higher index. The coded bits b_k, are mapped to the transmitted TFCI bits d_k, according to the following formula:

$$d_k = b_{k \bmod 32}$$

For uplink physical channels regardless of the SF and downlink physical channels, if SF≥128, $k = 0, 1, 2, \ldots, 29$. Note that this means that bits b_{30} and b_{31} are not transmitted.

For downlink physical channels whose SF < 128, $k = 0, 1, 2, \ldots, 119$. Note that this means that bits b_0 to b_{23} are transmitted four times and bits b_{24} to b_{31} are transmitted three times.

4.3.5.2 Mapping of TFCI word in compressed mode

The mapping of the TFCI bits in compressed mode is different for uplink, downlink with SF ≥ 128 and downlink with SF < 128.

4.3.5.2.1 Uplink compressed mode

For uplink compressed mode, the slot format is changed so that no TFCI coded bits are lost. The different slot formats in compressed mode do not match the exact number of TFCI coded bits for all possible TGLs. Repetition of the TFCI bits is therefore used.

Denote the number of bits available in the TFCI fields of one compressed radio frame by D and the number of bits in the TFCI field in a slot by N_{TFCI}. The parameter E is used to determine the number of the first TFCI bit to be repeated.

$E = N_{first} N_{TFCI}$, if the start of the transmission gap is allocated to the current frame.
$E = 0$, if the start of the transmission gap is allocated to the previous frame and the end of the transmission gap is allocated to the current frame.

The TFCI coded bits b_k are mapped to the bits in the TFCI fields d_k. The following relations define the mapping for each compressed frame.

$$d_k = b_k$$

where $k = 0, 1, 2, \ldots, \min(31, D-1)$.

If $D > 32$, the remaining positions are filled by repetition (in reversed order):

$$d_{D-k-1} = b_{(E+k) \bmod 32}$$

where $k = 0, \ldots, D-33$.

4.3.5.2.2 Downlink compressed mode

For downlink compressed mode, the slot format is changed so that no TFCI coded bits are lost. The different slot formats in compressed mode do not match the exact number of TFCI bits for all possible TGLs. DTX is therefore used if the number of bits available in the TFCI fields in one compressed frame exceeds the number of TFCI bits given from the slot format. The block of bits in the TFCI fields where DTX is used starts on the first TFCI field after the transmission gap. If there are more bits available in the TFCI fields before the transmission gap than TFCI bits, DTX is also used on the bits in the last TFCI fields before the transmission gap.

Denote the number of bits available in the TFCI fields of one compressed radio frame by D and the number of bits in the TFCI field in a slot by N_{TFCI}. The parameter E is used to determine the position of the first bit in the TFCI field on which DTX is used.

$E = N_{first} N_{TFCI}$, if the start of the transmission gap is allocated to the current frame.
$E = 0$, if the start of the transmission gap is allocated to the previous frame and the end of the transmission gap is allocated to the current frame.

Denote the total number of TFCI bits to be transmitted by F. $F = 32$ for slot formats nA or nB, where $n = 0, 1, \ldots, 11$ (see table 11 in [2]). Otherwise, $F = 128$. The TFCI coded bits b_k are mapped to the bits in the TFCI fields d_k. The following relations define the mapping for each compressed frame.

If $E > 0$,

$$d_k = b_{k \bmod 32}$$

where $k = 0, 1, 2, \ldots, \min(E, F)-1$.

If $E < F$,

$$d_{k+D-F} = b_{k \bmod 32}$$

where $k = E, \ldots, F-1$.

DTX is used on d_k where $k = \min(E, F), \ldots, \min(E, F) + D - F - 1$.

4.4 Compressed mode

In compressed frames, TGL slots from N_{first} to N_{last} are not used for transmission of data. As illustrated in figure 11, the instantaneous transmit power is increased in the compressed frame in order to keep the quality (BER, FER, etc.) unaffected by the reduced processing gain. The amount of power increase depends on the transmission time reduction method (see subclause 4.4.3). What frames are compressed, are decided by the network. When in compressed mode, compressed frames can occur periodically, as illustrated in figure 11, or requested on demand. The rate and type of compressed frames is variable and depends on the environment and the measurement requirements.

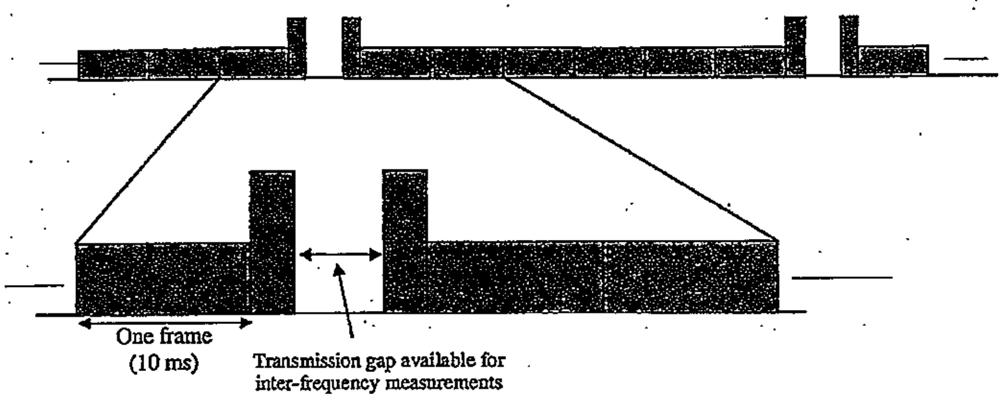


Figure 11: Compressed mode transmission.

4.4.1 Frame structure in the uplink

The frame structure for uplink compressed frames is illustrated in figure 12.

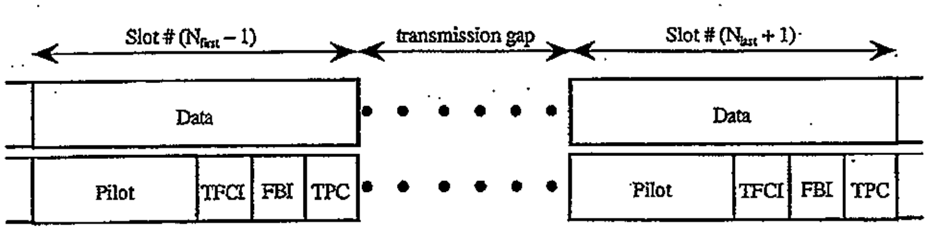


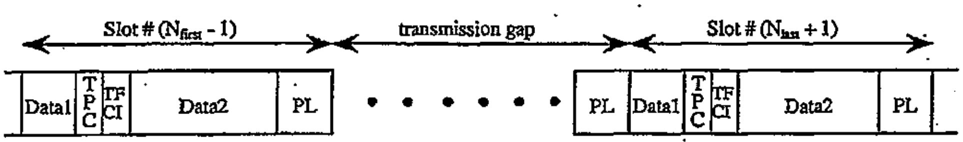
Figure 12: Frame structure in uplink compressed transmission

4.4.2 Frame structure types in the downlink

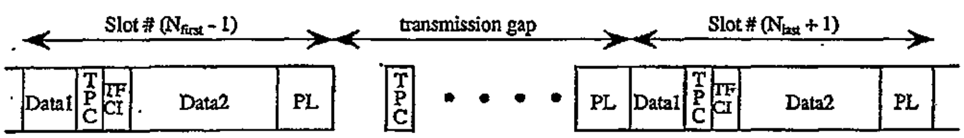
There are two different types of frame structures defined for downlink compressed frames. Type A maximises the transmission gap length and type B is optimised for power control. The frame structure type A or B is set by higher layers independent from the downlink slot format type A or B.

- With frame structure of type A, the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 13(a)). In case the length of the pilot field is 2 bits and STTD is used on the radio link, the pilot bits in the last slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits in the Data2 field.

- With frame structure of type B, the TPC field of the first slot in the transmission gap and the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 13(b)). In case the length of the pilot field is 2 bits and STTD is used on the radio link, the pilot bits in the last slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits of the Data2 field. Similarly, the TPC bits in the first slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits in the Data1 field.



(a) Frame structure type A



(b) Frame structure type B

Figure 13: Frame structure types in downlink compressed transmission

4.4.3 Transmission time reduction method

When in compressed mode, the information normally transmitted during a 10 ms frame is compressed in time. The mechanisms provided for achieving this are reduction of the spreading factor by a factor of two , and higher layer scheduling. In the downlink and the uplink, all methods are supported. The maximum idle length is defined to be 7 slots per one 10 ms frame. The slot formats that are used in compressed frames are listed in [2].

4.4.3.1 Void

4.4.3.2 Compressed mode by reducing the spreading factor by 2

The spreading factor (SF) can be reduced by 2 during one compressed radio frame to enable the transmission of the information bits in the remaining time slots of the compressed frame. This method is not supported for SF=4.

On the downlink, UTRAN can also order the UE to use a different scrambling code in a compressed frame than in a non-compressed frame. If the UE is ordered to use a different scrambling code in a compressed frame, then there is a one-to-one mapping between the scrambling code used in the non-compressed frame and the one used in the compressed frame, as described in [3] subclause 5.2.1.

4.4.3.3 Compressed mode by higher layer scheduling

Compressed frames can be obtained by higher layer scheduling. Higher layers then set restrictions so that only a subset of the allowed TFCs are used in a compressed frame. The maximum number of bits that will be delivered to the physical layer during the compressed radio frame is then known and a transmission gap can be generated. Note that in

the downlink, the TFCI field is expanded on the expense of the data fields and this shall be taken into account by higher layers when setting the restrictions on the TFCs. Compressed mode by higher layer scheduling shall not be used with fixed starting positions of the TrCHs in the radio frame.

4.4.4 Transmission gap position

Transmission gaps can be placed at different positions as shown in figures 14 and 15 for each purpose such as interfrequency power measurement, acquisition of control channel of other system/carrier, and actual handover operation.

When using single frame method, the transmission gap is located within the compressed frame depending on the transmission gap length (TGL) as shown in figure 14 (1). When using double frame method, the transmission gap is located on the center of two connected frames as shown in figure 14 (2).

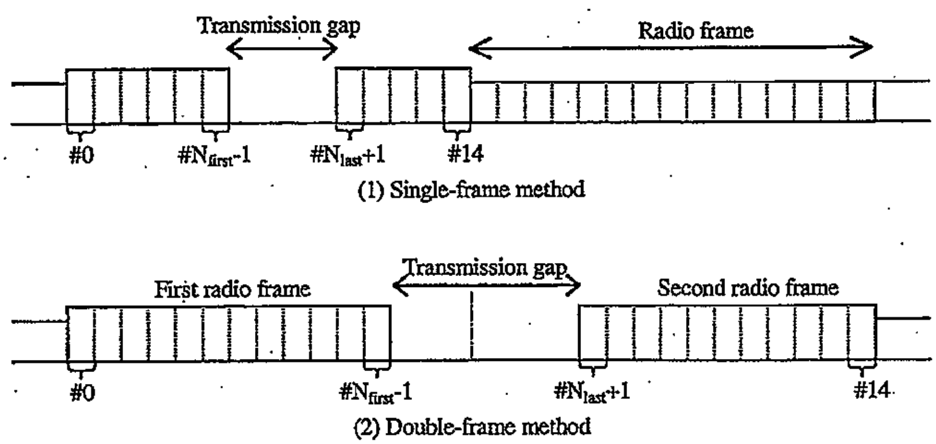


Figure 14: Transmission gap position

Parameters of the transmission gap positions are calculated as follows.

TGL is the number of consecutive idle slots during the compressed mode transmission gap:

$TGL = 3, 4, 5, 7, 10, 14$

N_{first} specifies the starting slot of the consecutive idle slots,

$N_{first} = 0,1,2,3,\ldots,14.$

N_{last} shows the number of the final idle slot and is calculated as follows;

If $N_{first} + TGL \le 15$, then $N_{last} = N_{first} + TGL - 1$ (in the same frame),

If $N_{first} + TGL > 15$, then $N_{last} = (N_{first} + TGL - 1) \bmod 15$ (in the next frame).

When the transmission gap spans two consecutive radio frames, N_{first} and TGL must be chosen so that at least 8 slots in each radio frame are transmitted.

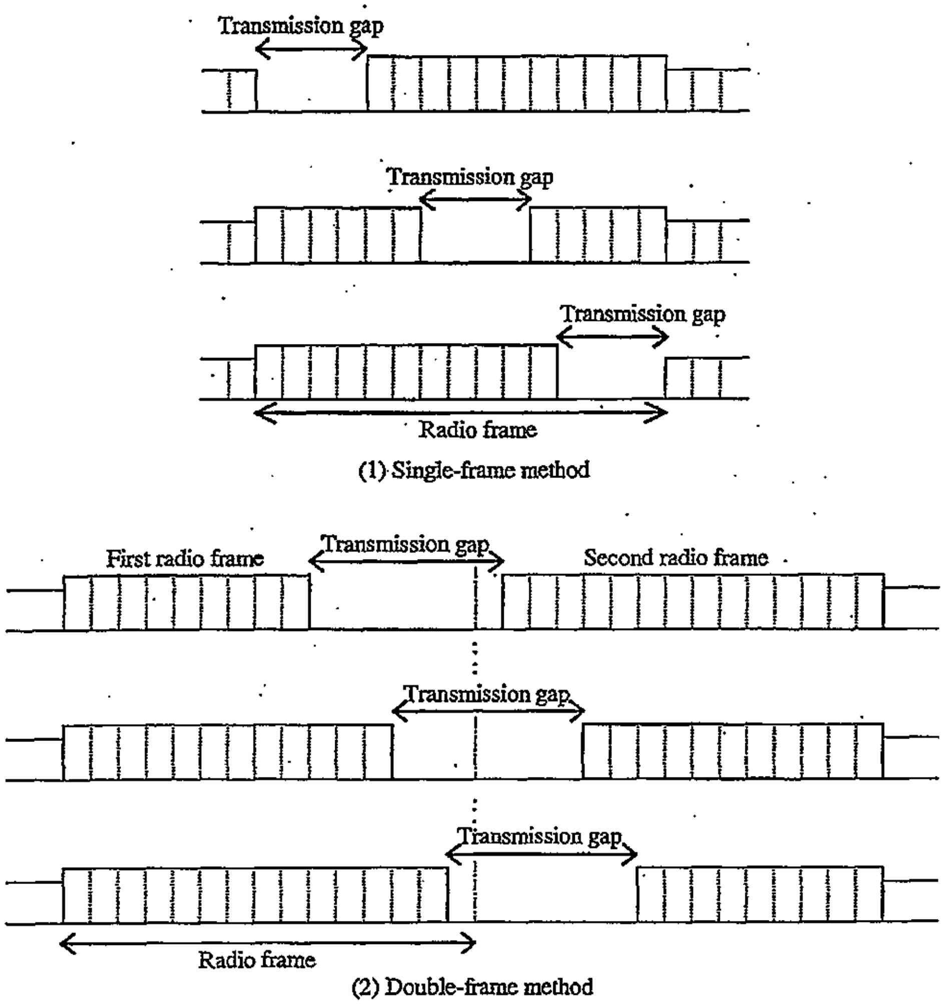


Figure 15: Transmission gap positions with different Nfirst

4.5 Coding for HS-DSCH

Data arrives to the coding unit in form of a maximum of one transport block once every transmission time interval. The transmission time interval is 2 ms which is mapped to a radio sub-frame of 3 slots.

The following coding steps can be identified:

- add CRC to each transport block (see subclause 4.5.1);
- bit scrambling (see subclause 4.5.1a);
- code block segmentation (see subclause 4.5.2);
- channel coding (see subclause 4.5.3);
- hybrid ARQ (see subclause 4.5.4);
- physical channel segmentation (see subclause 4.5.5);
- interleaving for HS-DSCH (see subclause 4.5.6);

- constellation re-arrangement for 16 QAM (see subclause 4.5.7);
- mapping to physical channels (see subclause 4.5.8).

The coding steps for HS-DSCH are shown in the figure below.

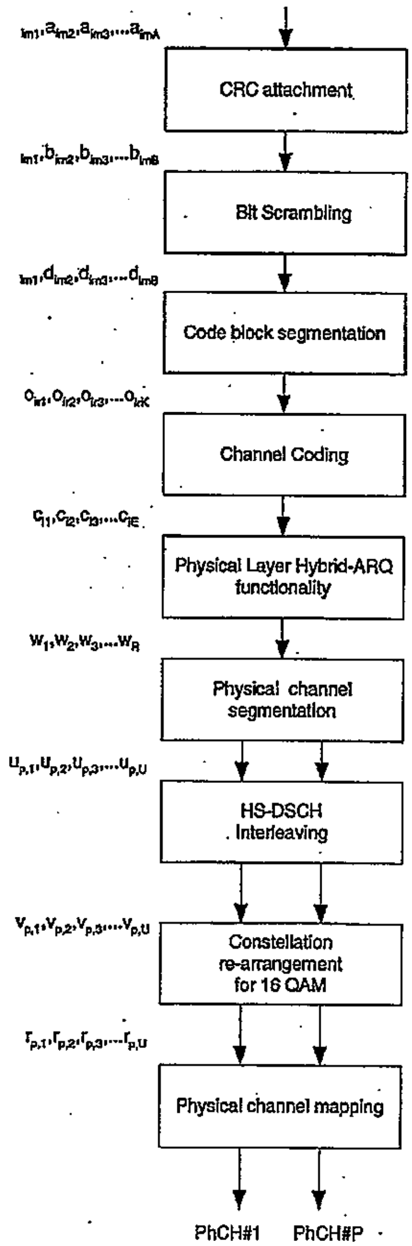


Figure 16: Coding chain for HS-DSCH

In the following the number of transport blocks and the number of transport channels is always one i.e. m=1, i=1. When referencing non HS-DSCH formulae which are used in correspondence with HS-DSCH formulae the convention is used that transport block subscripts may be omitted (e.g. X_1 may be written X).

4.5.1 CRC attachment for HS-DSCH

CRC attachment for the HS-DSCH transport channel shall be done using the general method described in 4.2.1 above with the following specific parameters.

The CRC length shall always be $L_1 = 24$ bits.

4.5.1a Bit scrambling for HS-DSCH

The bits output from the HS-DSCH CRC attachment are scrambled in the bit scrambler. The bits input to the bit scrambler are denoted by $b_{im,1}, b_{im,2}, b_{im,3}, \ldots, b_{im,B}$, where B is the number of bits input to the HS-DSCH bit scrambler

The bits after bit scrambling are denoted $d_{im,1}, d_{im,2}, d_{im,3}, \ldots, d_{im,B}$.

Bit scrambling is defined by the following relation:

$$d_{im,k} = \left(b_{im,k} + y_k\right) \bmod 2 \qquad k = 1,2,\ldots,B$$

and y_k results from the following operation:

$$y'_\gamma = 0 \quad -15 < \gamma < 1$$

$$y'_\gamma = 1 \qquad \gamma = 1$$

$$y'_\gamma = \left(\sum_{x=1}^{16} g_x \cdot y'_{\gamma-x}\right) \bmod 2 \quad 1 < \gamma \le B,$$

where $g = \{g_1, g_2, \ldots, g_{16}\} = \{0,0,0,0,0,0,0,0,0,0,1,0,1,1,0,1\}$,

$$y_k = y'_k \qquad k = 1,2,\ldots,B.$$

4.5.2 Code block segmentation for HS-DSCH

Code block segmentation for the HS-DSCH transport channel shall be done with the general method described in 4.2.2.2 above with the following specific parameters.

There will be a maximum of one transport block, i=1. The bits $d_{im1}, d_{im2}, d_{im3}, \ldots d_{imB}$ input to the block are mapped to the bits $x_{i1}, x_{i2}, x_{i3}, \ldots x_{iXi}$ directly. It follows that $X_1 = B$. Note that the bits x referenced here refer only to the internals of the code block segmentation function. The output bits from the code block segmentation function are $o_{ir1}, o_{ir2}, o_{ir3}, \ldots o_{irK}$.

The value of Z = 5114 for turbo coding shall be used.

4.5.3 Channel coding for HS-DSCH

Channel coding for the HS-DSCH transport channel shall be done with the general method described in 4.2.3 above with the following specific parameters.

There will be a maximum of one transport block, i=1. The rate 1/3 turbo coding shall be used.

4.5.4 Hybrid ARQ for HS-DSCH

The hybrid ARQ functionality matches the number of bits at the output of the channel coder to the total number of bits of the HS-PDSCH set to which the HS-DSCH is mapped. The hybrid ARQ functionality is controlled by the redundancy version (RV) parameters. The exact set of bits at the output of the hybrid ARQ functionality depends on the number of input bits, the number of output bits, and the RV parameters.

The hybrid ARQ functionality consists of two rate-matching stages and a virtual buffer as shown in the figure below.

The first rate matching stage matches the number of input bits to the virtual IR buffer, information about which is provided by higher layers. Note that, if the number of input bits does not exceed the virtual IR buffering capability, the first rate-matching stage is transparent.

The second rate matching stage matches the number of bits after first rate matching stage to the number of physical channel bits available in the HS-PDSCH set in the TTI.

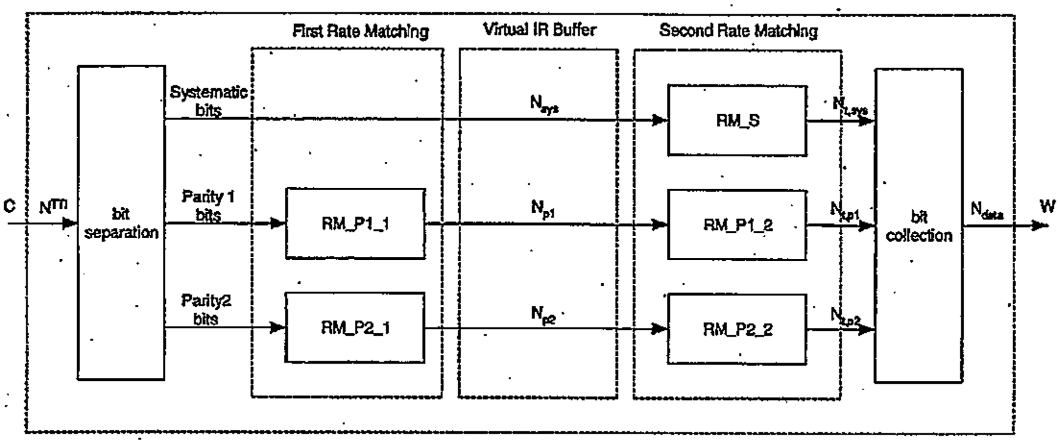


Figure 17: HS-DSCH hybrid ARQ functionality

4.5.4.1 HARQ bit separation

The HARQ bit separation function shall be performed in the same way as bit separation for turbo encoded TrCHs with puncturing in 4.2.7.4.1 above.

4.5.4.2 HARQ First Rate Matching Stage

HARQ first stage rate matching for the HS-DSCH transport channel shall be done with the general method described in 4.2.7.2.2.3 above with the following specific parameters.

The maximum number of soft channel bits available in the virtual IR buffer is N_{IR} which is signalled from higher layers for each HARQ process. The number of coded bits in a TTI before rate matching is N^{TTI} this is deduced from information signalled from higher layers and parameters signalled on the HS-SCCH for each TTI. Note that HARQ processing and physical layer storage occurs independently for each HARQ process currently active.

If N_{IR} is greater than or equal to N^{TTI} (i.e. all coded bits of the corresponding TTI can be stored) the first rate matching stage shall be transparent. This can, for example, be achieved by setting $e_{minus} = 0$. Note that no repetition is performed.

If N_{IR} is smaller than N^{TTI} the parity bit streams are punctured as in 4.2.7.2.2.3 above by setting the rate matching parameter $\Delta N_{il}^{TTI} = N_{IR} - N^{TTI}$ where the subscripts i and l refer to transport channel and transport format in the referenced sub-clause. Note the negative value is expected when the rate matching implements puncturing. Bits selected for puncturing which appear as δ in the algorithm in 4.2.7 above shall be discarded and not counted in the totals for the streams through the virtual IR buffer.

4.5.4.3 HARQ Second Rate Matching Stage

HARQ second stage rate matching for the HS-DSCH transport channel shall be done with the general method described in 4.2.7.5 above with the following specific parameters. Bits selected for puncturing which appear as δ in the algorithm in 4.2.7.5 above shall be discarded and are not counted in the streams towards the bit collection.

The parameters of the second rate matching stage depend on the value of the RV parameters s and r. The parameter s can take the value 0 or 1 to distinguish between transmissions that prioritise systematic bits (s = 1) and non systematic bits (s = 0). The parameter r (range 0 to r_{max}-1) changes the initial error variable e_{ini} in the case of puncturing. In case of

repetition both parameters r and s change the initial error variable e_{ini}. The parameters X_I, e_{plus} and e_{minus} are calculated as per table 10 below.

Denote the number of bits before second rate matching as N_{sys} for the systematic bits, N_{p1} for the parity 1 bits, and N_{p2} for the parity 2 bits, respectively. Denote the number of physical channels used for the HS-DSCH by P. N_{data} is the number of bits available to the HS-DSCH in one TTI and defined as $N_{data}=P\times3\times N_{data1}$, where N_{data1} is defined in [2]. The rate matching parameters are determined as follows.

For $N_{data} \le N_{sys} + N_{p1} + N_{p2}$, puncturing is performed in the second rate matching stage. The number of transmitted systematic bits in a transmission is $N_{t,sys} = \min\{N_{sys}, N_{data}\}$ for a transmission that prioritises systematic bits and $N_{t,sys} = \max\{N_{data} - (N_{p1} + N_{p2}), 0\}$ for a transmission that prioritises non systematic bits.

For $N_{data} > N_{sys} + N_{p1} + N_{p2}$ repetition is performed in the second rate matching stage. A similar repetition rate in all bit streams is achieved by setting the number of transmitted systematic bits to $N_{t,sys} = \left\lfloor N_{sys} \cdot \frac{N_{data}}{N_{sys} + 2N_{p1}} \right\rfloor$.

The number of parity bits in a transmission is: $N_{t,p1} = \left\lfloor \frac{N_{data} - N_{t,sys}}{2} \right\rfloor$ and $N_{t,p2} = \left\lceil \frac{N_{data} - N_{t,sys}}{2} \right\rceil$ for the parity 1 and parity 2 bits, respectively.

Table 10 below summarizes the resulting parameter choice for the second rate matching stage.

Table 10: Parameters for HARQ second rate matching

	X_I	e_{plus}	e_{minus}
Systematic RM S	N_{sys}	N_{sys}	$\lvert N_{sys} - N_{t,sys}\rvert$
Parity 1 RM P1_2	N_{p1}	$2 \cdot N_{p1}$	$2 \cdot \lvert N_{p1} - N_{t,p1}\rvert$
Parity 2 RM P2_2	N_{p2}	N_{p2}	$\lvert N_{p2} - N_{t,p2}\rvert$

The rate matching parameter e_{ini} is calculated for each bit stream according to the RV parameters r and s using

$e_{ini}(r) = \{(X_i - \lfloor r \cdot e_{plus} / r_{\max} \rfloor - 1) \bmod e_{plus}\} + 1$ in the case of puncturing, i.e., $N_{data} \le N_{sys} + N_{p1} + N_{p2}$, and

$e_{ini}(r) = \{(X_i - \lfloor (s + 2 \cdot r) \cdot e_{plus} / (2 \cdot r_{\max}) \rfloor - 1) \bmod e_{plus}\} + 1$ for repetition, i.e., $N_{data} > N_{sys} + N_{p1} + N_{p2}$. Where $r \in \{0, 1, \cdots, r_{\max} - 1\}$ and $r_{\max}$ is the total number of redundancy versions allowed by varying r as defined in 4.6.2. Note that r_{max} varies depending on the modulation mode, i.e. for 16QAM $r_{max} = 2$ and for QPSK $r_{max} = 4$.

Note: For the modulo operation the following clarification is used: the value of (x mod y) is strictly in the range of 0 to y-1 (i.e. -1 mod 10 = 9).

4.5.4.4 HARQ bit collection

The HARQ bit collection is achieved using a rectangular interleaver of size $N_{row} \times N_{col}$.

The number of rows and columns are determined from:

$$N_{row} = 4 \text{ for 16QAM and } N_{row} = 2 \text{ for QPSK}$$

$$N_{col} = N_{data} / N_{row}$$

where N_{data} is used as defined in 4.5.4.3.

Data is written into the interleaver column by column, and read out of the interleaver column by column starting from the first column.

$N_{t,sys}$ is the number of transmitted systematic bits. Intermediate values N_r and N_c are calculated using:

$$N_r = \left\lfloor \frac{N_{t,sys}}{N_{col}} \right\rfloor \text{ and } N_c = N_{t,sys} - N_r \cdot N_{col}.$$

If N_c=0 and N_r> 0, the systematic bits are written into rows 1...N_r.

Otherwise systematic bits are written into rows 1...N_r+1 in the first N_c columns and, if N_r> 0, also into rows 1...N_r in the remaining N_{col}-N_c columns.

The remaining space is filled with parity bits. The parity bits are written column wise into the remaining rows of the respective columns. Parity 1 and 2 bits are written in alternating order, starting with a parity 2 bit in the first available column with the lowest index number.

In the case of 16QAM for each column the bits are read out of the interleaver in the order row 1, row 2, row 3, row 4. In the case of QPSK for each column the bits are read out of the interleaver in the order row1, row2.

4.5.5 Physical channel segmentation for HS-DSCH

When more than one HS-PDSCH is used, physical channel segmentation divides the bits among the different physical channels. The bits input to the physical channel segmentation are denoted by $w_1, w_2, w_3, \ldots w_R$, where R is the number of bits input to the physical channel segmentation block. The number of PhCHs is denoted by P.

The bits after physical channel segmentation are denoted $u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU}$, where p is PhCH number and U is the number of bits in one radio sub-frame for each HS-PDSCH, i.e. $U = \frac{R}{P}$. The relation between w_k and $u_{p,k}$ is given below.

For all modes, some bits of the input flow are mapped to each code until the number of bits on the code is U.

Bits on first PhCH after physical channel segmentation:

$u_{1,k} = w_k \quad k = 1, 2, \ldots, U$

Bits on second PhCH after physical channel segmentation:

$u_{2,k} = w_{k+U} \quad k = 1, 2, \ldots, U$

...

Bits on the P^{th} PhCH after physical channel segmentation:

$u_{P,k} = w_{k+(P-1)\times U} \quad k = 1, 2, \ldots, U$

4.5.6 Interleaving for HS-DSCH

The interleaving for FDD is done as shown in figure 18 below, separately for each physical channel. The bits input to the block interleaver are denoted by $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U}$, where p is PhCH number and U is the number of bits in one TTI for one PhCH. For QPSK U = 960 and for 16QAM U = 1920. The basic interleaver is as the 2nd interleaver described in Section 4.2.11. The interleaver is of fixed size: R2=32 rows and C2=30 columns.

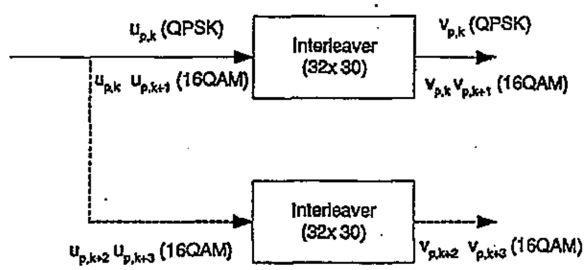


Figure 18: Interleaver structure for HS-DSCH

For 16QAM, there are two identical interleavers of the same fixed size R2×C2 = 32×30. The output bits from the physical channel segmentation are divided two by two between the interleavers: bits $u_{p,k}$ and $u_{p,k+1}$ go to the first interleaver and bits $u_{p,k+2}$ and $u_{p,k+3}$ go to the second interleaver. Bits are collected two by two from the interleavers: bits $v_{p,k}$ and $v_{p,k+1}$ are obtained from the first interleaver and bits $v_{p,k+2}$ and $v_{p,k+3}$ are obtained from the second interleaver, where k mod 4=1.

4.5.7 Constellation re-arrangement for 16 QAM

This function only applies to 16 QAM modulated bits. In case of QPSK it is transparent.

The following table describes the operations that produce the different rearrangements.

The bits of the input sequence are mapped in groups of 4 so that $v_{p,k}$, $v_{p,k+1}$, $v_{p,k+2}$, $v_{p,k+3}$ are used, where k mod 4 = 1.

Table 11: Constellation re-arrangement for 16 QAM

constellation version parameter *b*	Output bit sequence	Operation
0	$v_{p,k}v_{p,k+1}v_{p,k+2}v_{p,k+3}$	None
1	$v_{p,k+2}v_{p,k+3}v_{p,k}v_{p,k+1}$	Swapping MSBs with LSBs
2	$v_{p,k}v_{p,k+1}\overline{v_{p,k+2}}\,\overline{v_{p,k+3}}$	Inversion of the logical values of LSBs
3	$v_{p,k+2}v_{p,k+3}\overline{v_{p,k}}\,\overline{v_{p,k+1}}$	Swapping MSBs with LSBs and inversion of logical values of LSBs

The output bit sequences from the table above map to the output bits in groups of 4, i.e. $r_{p,k}$, $r_{p,k+1}$, $r_{p,k+2}$, $r_{p,k+3}$, where k mod 4 = 1.

4.5.8 Physical channel mapping for HS-DSCH

The HS-PDSCH is defined in [2]. The bits input to the physical channel mapping are denoted by $r_{p,1}, r_{p,2},...,r_{p,U}$, where *p* is the physical channel number and *U* is the number of bits in one radio sub-frame for one HS-PDSCH. The bits $r_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to *k*.

4.6 Coding for HS-SCCH

The following information is transmitted by means of the HS-SCCH physical channel.

- Channelization-code-set information (7 bits): $x_{ccs,1}, x_{ccs,2}, ..., x_{ccs,7}$
- Modulation scheme information (1 bit): $x_{ms,1}$
- Transport-block size information (6 bits): $x_{tbs,1}, x_{tbs,2}, ..., x_{tbs,6}$
- Hybrid-ARQ process information (3 bits): $x_{hap,1}, x_{hap,2}, x_{hap,3}$

- Redundancy and constellation version (3 bits): $x_{rv,1}, x_{rv,2}, x_{rv,3}$
- New data indicator (1 bit): $x_{nd,1}$
- UE identity (16 bits): $x_{ue,1}, x_{ue,2}, \ldots, x_{ue,16}$

4.6.1 Overview

Figure 19 below illustrates the overall coding chain for HS-SCCH.

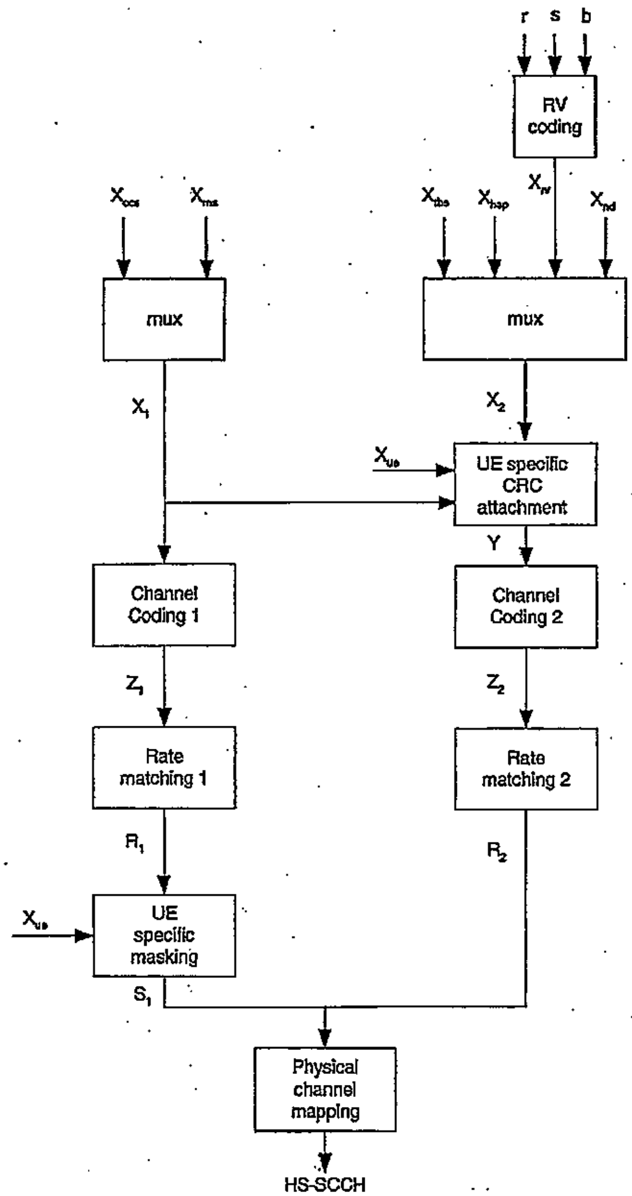


Figure 19: Coding chain for HS-SCCH

4.6.2 HS-SCCH information field mapping

4.6.2.1 Redundancy and constellation version coding

The redundancy version (RV) parameters *r*, *s* and constellation version parameter *b* are coded jointly to produce the value X_{rv}. X_{rv} is alternatively represented as the sequence $x_{rv,1}$, $x_{rv,2}$, $x_{rv,3}$ where $x_{rv,1}$ is the MSB. This is done according to the following tables according to the modulation mode used:

Table 12: RV coding for 16 QAM

X_{rv} (value)	s	r	b
0	1	0	0
1	0	0	0
2	1	1	1
3	0	1	1
4	1	0	1
5	1	0	2
6	1	0	3
7	1	1	0

Table 13: RV coding for QPSK

X_{rv} (value)	s	r
0	1	0
1	0	0
2	1	1
3	0	1
4	1	2
5	0	2
6	1	3
7	0	3

4.6.2.2 Modulation scheme mapping

The value of $x_{ms,1}$ is derived from the modulation and given by the following:

$$x_{ms,1} = \begin{cases} 0 & if \quad QPSK \\ 1 & if \quad 16QAM \end{cases}$$

4.6.2.3 Channelization code-set mapping

The channelization code-set bits $x_{ccs,1}$, $x_{ccs,2}$, ..., $x_{ccs,7}$ are coded according to the following:

Given P (multi-)codes starting at code O calculate the information-field using the unsigned binary representation of integers calculated by the expressions,

for the first three bits (code group indicator) of which $x_{ccs,1}$ is the MSB:

$$x_{ccs,1}, x_{ccs,2}, x_{ccs,3} = \min(P-1, 15-P)$$

for the last four bits (code offset indicator) of which $x_{ccs,4}$ is the MSB:

$$x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,7} = |O-1-\lfloor P/8 \rfloor * 15|$$

The definitions of P and O are given in [3].

4.6.2.4 UE identity mapping

The UE identity is the HS-DSCH Radio Network Identifier (H-RNTI) defined in [13]. This is mapped such that $x_{ue,1}$ corresponds to the MSB and $x_{ue,16}$ to the LSB, cf. [14].

4.6.2.5 HARQ process identifier mapping

Hybrid-ARQ process information (3 bits) $x_{hap,1}$, $x_{hap,2}$, $x_{hap,3}$ is unsigned binary representation of the HARQ process identifier where $x_{hap,1}$ is MSB.

4.6.2.6 Transport block size index mapping

Transport-block size information (6 bits) $x_{tbs,1}$, $x_{tbs,2}$, ..., $x_{tbs,6}$ is unsigned binary representation of the Transport block size index where $x_{tbs,1}$ is MSB.

4.6.3 Multiplexing of HS-SCCH information

The channelization-code-set information $x_{ccs,1}$, $x_{ccs,2}$, ..., $x_{ccs,7}$ and modulation-scheme information $x_{ms,1}$ are multiplexed together. This gives a sequence of bits $x_{1,1}$, $x_{1,2}$, ..., $x_{1,8}$ where

$x_{1,i} = x_{ccs,i}$ $\quad i=1,2,...,7$

$x_{1,i} = x_{ms,i\text{-}7}$ $\quad i=8$

The transport-block-size information $x_{tbs,1}$, $x_{tbs,2}$, ..., $x_{tbs,6}$, Hybrid-ARQ-process information $x_{hap,1}$,$x_{hap,2}$, $x_{hap,3}$, redundancy-version information $x_{rv,1}$, $x_{rv,2}$, $x_{rv,3}$ and new-data indicator $x_{nd,1}$ are multiplexed together. This gives a sequence of bits $x_{2,1}$, $x_{2,2}$, ..., $x_{2,13}$ where

$x_{2,i} = x_{tbs,i}$ $\quad i=1,2,...,6$

$x_{2,i} = x_{hap,i\text{-}6}$ $\quad i=7,8,9$

$x_{2,i} = x_{rv,i\text{-}9}$ $\quad i=10,11,12$

$x_{2,i} = x_{nd,i\text{-}12}$ $\quad i=13$

4.6.4 CRC attachment for HS-SCCH

From the sequence of bits $x_{1,1}$, $x_{1,2}$, ..., $x_{1,8}$, $x_{2,1}$, $x_{2,2}$, ..., $x_{2,13}$ a 16 bits CRC is calculated according to Section 4.2.1.1. This gives a sequence of bits c_1, c_2, ..., c_{16} where

$c_k = p_{im(17-k)}$ $\quad k=1,2,...,16$

This sequence of bits is then masked with the UE Identity $x_{ue,1}$, $x_{ue,2}$, ..., $x_{ue,16}$ and then appended to the sequence of bits $x_{2,1}$, $x_{2,2}$, ..., $x_{2,13}$ to form the sequence of bits y_1, y_2, ..., y_{29}, where

$y_i = x_{2,i}$ $\quad i=1,2,...,13$

$y_i = (c_{i\text{-}13} + x_{ue,i\text{-}13}) \bmod 2$ $\quad i=14,15,...,29$

4.6.5 Channel coding for HS-SCCH

Rate 1/3 convolutional coding, as described in Section 4.2.3.1, is applied to the sequence of bits $x_{1,1}$,$x_{1,2}$, ...,$x_{1,8}$. This gives a sequence of bits $z_{1,1}$, $z_{1,2}$, ..., $z_{1,48}$.

Rate 1/3 convolutional coding, as described in Section 4.2.3.1, is applied to the sequence of bits y_1, y_2, ..., y_{29}. This gives a sequence of bits $z_{2,1}$, $z_{2,2}$, ..., $z_{2,111}$.

Note that the coded sequence lengths result from the termination of K=9 convolutional coding being fully applied.

4.6.6 Rate matching for HS-SCCH

From the input sequence $z_{1,1}, z_{1,2}, \ldots, z_{1,48}$ the bits $z_{1,1}, z_{1,2}, z_{1,4}, z_{1,8}, z_{1,42}, z_{1,45}, z_{1,47}, z_{1,48}$ are punctured to obtain the output sequence $r_{1,1}, r_{1,2} \ldots r_{1,40}$.

From the input sequence $z_{2,1}, z_{2,2}, \ldots, z_{2,111}$ the bits $z_{2,1}, z_{2,2}, z_{2,3}, z_{2,4}, z_{2,5}, z_{2,6}, z_{2,7}, z_{2,8}, z_{2,12}, z_{2,14}, z_{2,15}, z_{2,24}, z_{2,42}, z_{2,48}, z_{2,54}, z_{2,57}, z_{2,60}, z_{2,66}, z_{2,69}, z_{2,96}, z_{2,99}, z_{2,101}, z_{2,102}, z_{2,104}, z_{2,105}, z_{2,106}, z_{2,107}, z_{2,108}, z_{2,109}, z_{2,110}, z_{2,111}$ are punctured to obtain the output sequence $r_{2,1}, r_{2,2} \ldots r_{2,80}$.

4.6.7 UE specific masking for HS-SCCH

The rate matched bits $r_{1,1}, r_{1,2} \ldots r_{1,40}$ shall be masked in an UE specific way using the UE identity $x_{ue,1}, x_{ue,2}, \ldots, x_{ue,16}$ to produce the bits $s_{1,1}, s_{1,2} \ldots s_{1,40}$.

Intermediate code word bits b_i, i=1,2…,48, are defined by endcoding the UE identity bits using the rate ½ convolutional coding described in Section 4.2.3.1. Eight bits out of the resulting 48 convolutionally encoded bits are punctured using the rate matching rule of Section 4.6.6 for the HS-SCCH part 1 sequence, that is, the intermediate code word bits b_1, b_2, b_4, b_8, b_{42}, b_{45}, b_{47}, b_{48}, are punctured to obtain the 40 bit UE specific scrambling sequence $c_1, c_2, \ldots c_{40}$.

The mask output bits $s_{1,1}, s_{1,2} \ldots s_{1,40}$ are calculated as follows:

$s_{1,k} = (r_{1,k} + c_k) \bmod 2$ for k = 1,2..40

4.6.8 Physical channel mapping for HS-SCCH

The HS-SCCH sub-frame is described in[2].

The sequence of bits $s_{1,1}, s_{1,2}, \ldots, s_{1,40}$ is mapped to the first slot of the HS-SCCH sub frame. The bits $s_{1,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

The sequence of bits $r_{2,1}, r_{2,2}, \ldots, r_{2,80}$ is mapped to the second and third slot of the HS-SCCH sub frame. The bits $r_{2,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

4.7 Coding for HS-DPCCH

Data arrives to the coding unit in form of indicators for measurement indication and HARQ acknowledgement.

The following coding/multiplexing steps can be identified:

- channel coding (see subclause 4.7.1);
- mapping to physical channels (see subclause 4.7.2).

The general coding flow is shown in the figure below. This is done in parallel for the HARQ-ACK and CQI as the flows are not directly multiplexed but are transmitted at different times.

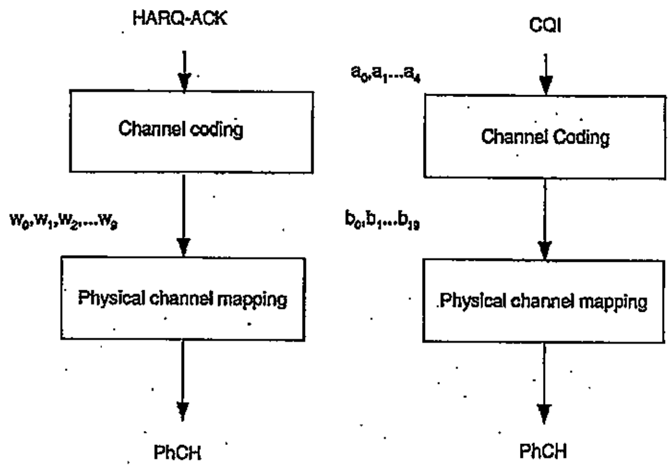


Figure 20: Coding for HS-DPCCH

4.7.1 Channel coding for HS-DPCCH

Two forms of channel coding are used, one for the channel quality information (CQI) and another for HARQ-ACK (acknowledgement).

4.7.1.1 Channel coding for HS-DPCCH HARQ-ACK

The HARQ acknowledgement message to be transmitted, as defined in [4], shall be coded to 10 bits as shown in Table 13A. The output is denoted $w_0, w_1,\ldots w_9$.

Table 13A: Channel coding of HARQ-ACK

HARQ-ACK message to be transmitted	w_0	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9
ACK	1	1	1	1	1	1	1	1	1	1
NACK	0	0	0	0	0	0	0	0	0	0

4.7.1.2 Channel coding for HS-DPCCH channel quality information

The channel quality information is coded using a (20,5) code. The code words of the (20,5) code are a linear combination of the 5 basis sequences denoted $M_{i,n}$ defined in the table below.

Table 14: Basis sequences for (20,5) code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	0	1

The CQI values 0 .. 30 as defined in [4] are converted from decimal to binary to map them to the channel quality information bits (1 0 0 0 0) to (1 1 1 1 1) respectively. The information bit pattern (0 0 0 0 0) shall not be used in this release. The channel quality information bits are a_0, a_1, a_2, a_3, a_4 (where a_0 is LSB and a_4 is MSB). The output code word bits b_i are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where $i = 0, \ldots, 19$.

4.7.2 Physical channel mapping for HS-DPCCH

The HS-DPCCH physical channel mapping function shall map the input bits w_k directly to physical channel so that bits are transmitted over the air in ascending order with respect to k.

The HS-DPCCH physical channel mapping function shall map the input bits b_k directly to physical channel so that bits are transmitted over the air in ascending order with respect to k.

Annex A (informative): Blind transport format detection

A.1 Blind transport format detection using fixed positions

A.1.1 Blind transport format detection using received power ratio

For the dual transport format case (the possible data rates are 0 and full rate, and CRC is only transmitted for full rate), blind transport format detection using received power ratio can be used.

The transport format detection is then done using average received power ratio of DPDCH to DPCCH. Define the following:

- *Pc:* Received power per bit of DPCCH calculated from all pilot and TPC bits per slot over a radio frame;
- *Pd:* Received power per bit of DPDCH calculated from *X* bits per slot over a radio frame;
- *X:* the number of DPDCH bits per slot when transport format corresponds to full rate;
- *T:* Threshold of average received power ratio of DPDCH to DPCCH for transport format detection.

The decision rule can then be formulated as:

If *Pd/Pc >T* then:

- full rate transport format detected;

else

- zero rate transport format detected.

A.1.2 Blind transport format detection using CRC

For the multiple transport format case (the possible data rates are 0, ..., (full rate)/r, ..., full rate, and CRC is transmitted for all transport formats), blind transport format detection using CRC can be used.

At the transmitter, the data stream with variable number of bits from higher layers is block-encoded using a cyclic redundancy check (CRC) and then convolutionally encoded. CRC parity bits are attached just after the data stream with variable number of bits as shown in figure A.1.

The receiver knows only the possible transport formats (or the possible end bit position $\{n_{end}\}$) by Layer-3 negotiation. The receiver performs Viterbi-decoding on the soft decision sample sequence. The correct trellis path of the Viterbi-decoder ends at the zero state at the correct end bit position.

The blind transport format detection method using CRC traces back the surviving trellis path ending at the zero state (hypothetical trellis path) at each possible end bit position to recover the data sequence. For each recovered data sequence error-detection is performed by checking the CRC, and if there is no error, the recovered sequence is declared to be correct.

The following variable is defined:

$$s(n_{end}) = -10 \log ((a_0(n_{end}) - a_{min}(n_{end})) / (a_{max}(n_{end}) - a_{min}(n_{end}))) \text{ [dB]} \quad \text{(Eq. 1)}$$

where $a_{max}(n_{end})$ and $a_{min}(n_{end})$ are the maximum and minimum path-metric values among all survivors at end bit position n_{end}, and $a_0(n_{end})$ is the path-metric value at zero state.

In order to reduce the probability of false detection (this happens if the selected path is wrong but the CRC misses the error detection), a path selection threshold D is introduced. The threshold D determines whether the hypothetical trellis path connected to the zero state should be traced back or not at each end bit position n_{end}. If the hypothetical trellis path connected to the zero state that satisfies:

$s(n_{end}) \leq D$ (Eq. 2)

is found, the path is traced back to recover the frame data, where D is the path selection threshold and a design parameter.

If more than one end bit positions satisfying Eq. 2 is found, the end bit position which has minimum value of $s(n_{end})$ is declared to be correct. If no path satisfying Eq. 2 is found even after all possible end bit positions have been exhausted, the received frame data is declared to be in error.

Figure A-2 shows the procedure of blind transport format detection using CRC.

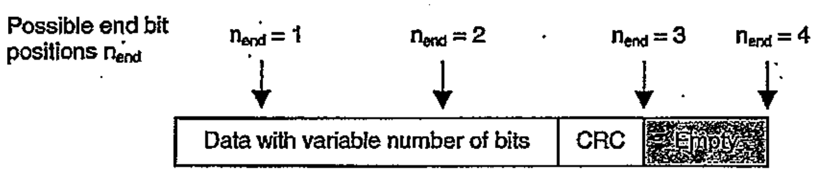


Figure A.1: An example of data with variable number of bits. Four possible transport formats, and transmitted end bit position nend = 3

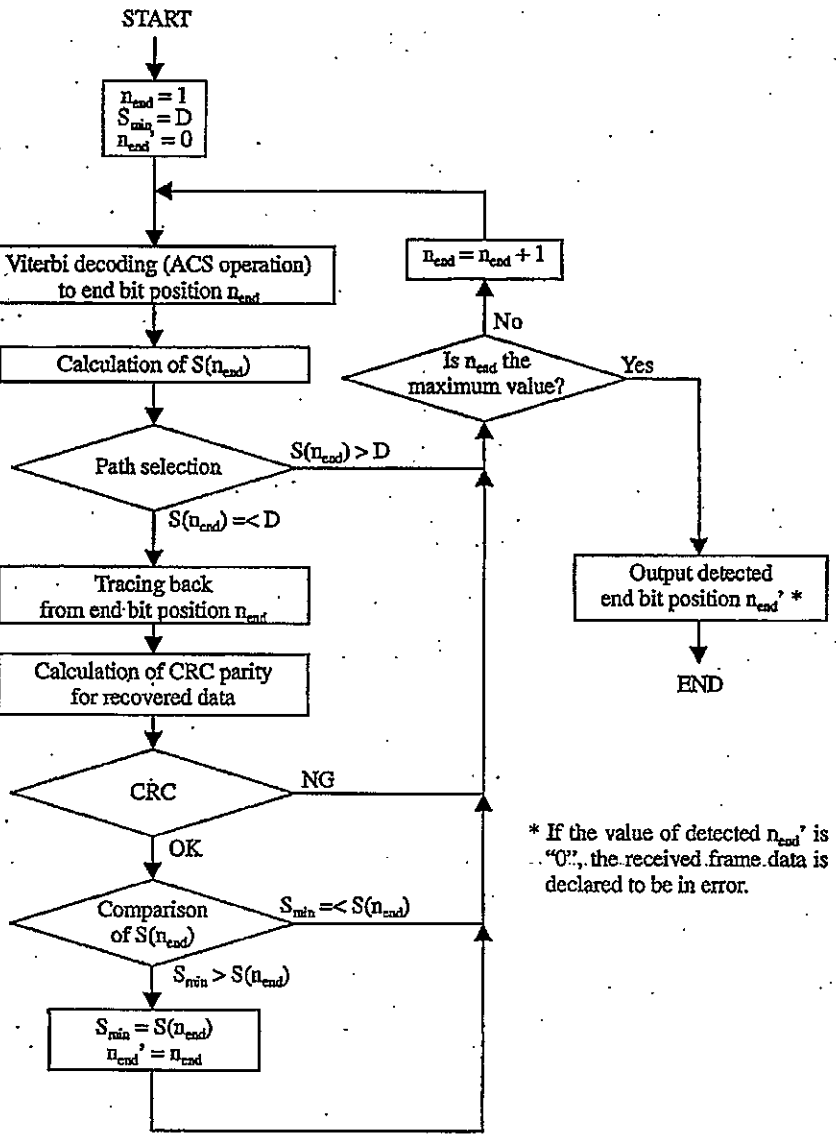


Figure A.2: Basic processing flow of blind transport format detection

Annex B (informative): Compressed mode idle lengths

The tables B.1-B.3 show the resulting idle lengths for different transmission gap lengths, UL/DL modes and DL frame types. The idle lengths given are calculated purely from the slot and frame structures and the UL/DL offset. They do not contain margins for e.g. synthesizer switching.

B.1 Idle lengths for DL, UL and DL+UL compressed mode

Table B.1: Parameters for DL compressed mode

TGL	DL Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A	512 – 4	1.73 – 1.99	Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
	B		1.60 – 1.86		
4	A		2.40 – 2.66		(S) (D) =(1,3), (2,2) or (3,1)
	B		2.27 – 2.53		
5	A		3.07 – 3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
	B		2.93 – 3.19		
7	A		4.40 – 4.66		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
	B		4.27 – 4.53		
10	A		6.40 – 6.66		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
	B		6.27 – 6.53		
14	A		9.07 – 9.33		(D) =(7,7)
	B		8.93 – 9.19		

Table B.2: Parameters for UL compressed mode

TGL	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	256 – 4	2.00	Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
4		2.67		(S) (D) =(1,3), (2,2) or (3,1)
5		3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
7		4.67		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
10		6.67		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
14		9.33		(D) =(7,7)

Table B.3: Parameters for combined UL/DL compressed mode

TGL	DL Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A or B	DL: 512 – 4 UL: 256 – 4	1.47 – 1.73	Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
4			2.13 – 2.39		(S) (D) =(1,3), (2,2) or (3,1)
5			2.80 – 3.06		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
7			4.13 – 4.39		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
10			6.13 – 6.39		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
14			8.80 – 9.06		(D) =(7,7)

(S): Single-frame method as shown in figure 14 (1).

(D): Double-frame method as shown in figure 14 (2). (x,y) indicates x: the number of idle slots in the first frame, y: the number of idle slots in the second frame.

NOTE: Compressed mode by spreading factor reduction is not supported when SF=4 is used in normal mode

Annex C (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
	RAN_05	RP-99588	-		Approved at TSG RAN #5 and placed under Change Control	-	3.0.0
14/01/00	RAN_06	RP-99680	001	3	Correction of rate matching parameters for repetition after 1st unterleaving in 25.212	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	004	-	Changing the initial offset value for convolutional code rate matching	3.0.0	3.1.0
14/01/00	RAN_06	RP-99681	005	1	Introduction of compressed mode by higher layer scheduling	3.0.0	3.1.0
14/01/00	RAN_06	RP-99679	008	-	Editorial corrections to TS 25.212	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	009	-	Removal of SFN multiplexing	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	010	1	Clarification of bit separation and collection	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	011	2	Connection between TTI and CFN	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	012	2	Zero length transport blocks	3.0.0	3.1.0
14/01/00	RAN_06	RP-99679	014	-	Update of channel coding sections	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	016	-	Removal of TrCH restriction in DSCH CCTrCH	3.0.0	3.1.0
14/01/00	RAN_06	RP-99681	017	-	20 ms RACH message length	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	018	-	Minimum SF in UL	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	024	-	Rate matching parameter determination in DL and fixed positions	3.0.0	3.1.0
14/01/00	RAN_06	RP-99680	026	1	Corrections to TS 25.212	3.0.0	3.1.0
14/01/00	RAN_06	RP-99679	027	-	Modification of BTFD description in 25.212 Annex	3.0.0	3.1.0
14/01/00	RAN_06	RP-99681	028	-	TFCI coding and mapping including compressed mode	3.0.0	3.1.0
14/01/00	-	-	-		Change history was added by the editor	3.1.0	3.1.1
31/03/00	RAN_07	RP-000061	025	2	CR for parity bit attachment to 0 bit transport block	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	029	1	Limitations of blind transport format detection	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	034	1	Clarification of fixed position rate matching	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	035	1	Clarification of DL compressed mode	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	036	-	Reconfiguration of TFCS	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	037	1	Removal of fixed gap position in 25.212	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	038	2	Definition clarification for TS 25.212	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	039	1	Clarification on TFCI coding input	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	041	2	Correction of UL compressed mode by higher layer scheduling	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	042	5	Downlink Compressed Mode by puncturing	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	044	-	Modification of Turbo code internal interleaver	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	045	-	Editorial corrections	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	046	-	SF/2 method: DTX insertion after 2nd interleaver	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	047	1	TFCI coding for FDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	048	-	Mapping of TFCI in downlink compressed mode.	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	049	-	Editorial changes to Annex A	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	050	-	Removal of rate matching attribute setting for RACH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	052	-	Padding Function for Turbo coding of small blocks	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	055	2	Clarifications relating to DSCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000061	056	-	Editorial modification of uplink shifting parameter calculation for turbo code puncturing	3.1.1	3.2.0
31/03/00	RAN_07	RP-000062	059	1	Revision: Editorial correction to the calculation of Rate Matching parameters	3.1.1	3.2.0
31/03/00	RAN_07	RP-000062	060	1	Editorial changes of channel coding section	3.1.1	3.2.0
31/03/00	RAN_07	RP-000062	061	-	Removal of DL compressed mode by higher layer scheduling with fixed positions	3.1.1	3.2.0
26/06/00	RAN_08	RP-000266	066	1	Section 4.4.5 and table 9 is moved to informative annex	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	068	-	Editorial modifications of 25.212	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	069	-	Removal of BTFD for flexible positions in Release 99	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	070	1	Editorial modifications	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	071	1	Corrections and editorial modifications of 25.212 for 2nd insertion of DTX bits for CM	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	072	4	Corrections to 25.212 (Rate Matching, p-bit insertion, PhCH segmentation)	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	073	-	Editorial correction in 25.212 coding/multiplexing	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	074	2	Bit separation of the Turbo encoded data	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	076	1	Revision of code block segmentation description	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	077	-	Clarifications for TFCI coding	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	078	2	Clarifying the rate matching parameter setting for the RACH and BCH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	080	-	Clarification on BTFD utilisation (single CCTrCH)	3.2.0	3.3.0

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
26/06/00	RAN_08	RP-000266	081	-	Correction of order of checking TFC during flexible position RM parameter determination	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	082	-	Editorial corrections in channel coding section	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	083	-	Correction for bit separation and bit collection	3.2.0	3.3.0
26/06/00	RAN_08	RP-000266	084	1	Correction on the spreading factor selection for the RACH	3.2.0	3.3.0
23/09/00	RAN_09	RP-000341	079	-	Clarification of compressed mode terminology	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	085	1	Editorial corrections in Turbo code internal interleaver section	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	086	1	Clarification on DL slot format for compressed mode by SF/2	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	087	-	Corrections	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	088	1	Clarifications to TS 25.212	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	089	-	Correction regarding DSCH	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	090	-	Correction regarding CPCH	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	092	1	Bit separation and collection for rate matching	3.3.0	3.4.0
23/09/00	RAN_09	RP-000341	093	-	Puncturing Limit definition in WG1 specification	3.3.0	3.4.0
15/12/00	RAN_10	RP-000538	094	2	Correction of BTFD limitations	3.4.0	3.5.0
15/12/00	RAN_10	RP-000538	096	-	Compressed mode by puncturing	3.4.0	3.5.0
15/12/00	RAN_10	RP-000538	097	-	Clarification on the Ci formula	3.4.0	3.5.0
15/12/00	RAN_10	RP-000538	099	-	Editorial modification in RM section	3.4.0	3.5.0
15/12/00	RAN_10	RP-000538	100	1	Editorial corrections in TS 25.212	3.4.0	3.5.0
15/12/00	RAN_10	RP-000538	101	-	Correction to code block segmentation	3.4.0	3.5.0

Change history

Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
16/03/01	RAN_11	-	-	-	Approved as Release 4 specification (v4.0.0) at TSG RAN #11	3.5.0	4.0.0
15/06/01	RAN_12	RP-010332	106	-	Correction of compressed mode by puncturing	4.0.0	4.1.0
15/06/01	RAN_12	RP-010332	108	1	Dual transport format detection	4.0.0	4.1.0
15/06/01	RAN_12	RP-010332	112	1	Correction for downlink rate matching for the DSCH	4.0.0	4.1.0
21/09/01	RAN_13	RP-010519	115	-	Correction of PDSCH spreading factor signalling.	4.1.0	4.2.0
14/12/01	RAN_14	RP-010737	118	-	Clarification of compressed mode	4.2.0	4.3.0
14/12/01	RAN_14	RP-010737	122	-	Support of multiple CCTrChs of dedicated type	4.2.0	4.3.0
08/03/02	RAN_15	RP-020231	128	2	Removal of channel coding option 'no coding' for FDD	4.3.0	4.4.0
08/03/02	RAN_15	RP-020054	123	4	Inclusion of flexible hard split mode TFCI operation	4.3.0	5.0.0
08/03/02	RAN_15	RP-020058	126	1	Changes to 25.212 for HSDPA work item	4.3.0	5.0.0
07/06/02	RAN_16	RP-020308	136	-	Downlink bit mapping	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	130	5	Correction of Errata noted by RAN1 delegates	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	131	2	Removal of inconsistencies and ambiguities in the HARQ description	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	132	-	Rate Matching and Channel Coding for HS-SCCH	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	137	-	Basis sequences for HS-DPCCH Channel Quality Information code	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	145	5	UE specific masking for HS-SCCH part1	5.0.0	5.1.0
14/09/02	RAN_17	RP-020582	141	1	Bit scrambling for HS-DSCH	5.1.0	5.2.0
15/09/02	RAN_17	RP-020582	148		Physical channel mapping for HS-DPCCH	5.1.0	5.2.0
15/09/02	RAN_17	RP-020582	149		HARQ bit collection	5.1.0	5.2.0
15/09/02	RAN_17	RP-020582	150	1	Coding for HS-SCCH	5.1.0	5.2.0
15/09/02	RAN_17	RP-020582	151		Correction to UE specific masking for HS-SCCH part1	5.1.0	5.2.0
15/09/02	RAN_17	RP-020568	155	2	Clarification of the definition of layer 1 transport channel numbers	5.1.0	5.2.0
15/09/02	RAN_17	RP-020573	157		Numbering Corrections	5.1.0	5.2.0
15/09/02	RAN_17	RP-020645	158	1	Specification of H-RNTI to UE identity mapping	5.1.0	5.2.0
20/12/02	RAN_18	RP-020846	163	-	Correction of CQI index to bit mapping	5.2.0	5.3.0
20/12/02	RAN_18	RP-020846	164	-	Correction of mapping of HARQ-ACK	5.2.0	5.3.0
26/03/03	RAN_19	RP-030134	165	1	Correction of CQI index to bit mapping	5.3.0	5.4.0
26/03/03	RAN_19	RP-030134	166	3	Correction of bit scrambling of HS-DSCH	5.3.0	5.4.0
26/03/03	RAN_19	RP-030134			Correction of subscript for modulation scheme information	5.3.0	5.4.0
23/06/03	RAN_20	RP-030272	172	1	Clarification of TPC and Pilot transmission with STTD in compressed mode	5.4.0	5.5.0
23/06/03	RAN_20	RP-030272	173	2	Correction on the flexible TFCI coding in the DSCH hard split mode for Rel5	5.4.0	5.5.0
21/09/03	RAN_21	RP-030456	178	4	Clarification on Single Transport Format Detection	5.5.0	5.6.0
21/09/03	RAN_21	RP-030456	179	-	Correction on table number in first interleave description	5.5.0	5.6.0
21/09/03	RAN_21	RP-030456	180	3	Broadening the conditions that require UEs to perform BTFD for the case of HS-DSCH reception	5.5.0	5.6.0
06/01/04	RAN_22	RP-030647	183	-	Clarification of the CRC attachment procedure for HS-SCCH	5.6.0	5.7.0
06/01/04	RAN_22	RP-030647	184	1	Correction of UE identity notation	5.6.0	5.7.0
06/01/04	RAN_22	RP-030644	185	-	HARQ process identifier mapping	5.6.0	5.7.0
06/01/04	RAN_22	RP-030712	186		Alignment of terminology across 3GPP documentation	5.6.0	5.7.0
23/03/04	RAN_23	RP-040085	181	3	CCTrCH definition extension to HS-DSCH	5.7.0	5.8.0
09/06/04	RAN_24	RP-040230	190	1	Clarification of Channelization Code-Set Mapping	5.8.0	5.9.0
16/06/05	RAN_28	RP-050241	202	-	Correction of HSDPA Bit Separation	5.9.0	5.10.0
16/06/05	RAN_28	RP-050250	207	1	Feature Clean Up: Removal of 'CPCH'	5.9.0	5.10.0
16/06/05	RAN_28	RP-050248	209	-	Feature Clean Up: Removal of DSCH (FDD mode)	5.9.0	5.10.0
16/06/05	RAN_28	RP-050243	211	1	Feature Clean-Up: Removal of 80 ms TTI for DCH for all other cases but when the UE supports SF512	5.9.0	5.10.0
16/06/05	RAN_28	RP-050249	213	1	Feature clean up: Removal of the 'compressed mode by puncturing'	5.9.0	5.10.0

History

Document history		
V5.0.0	March 2002	Publication
V5.1.0	June 2002	Publication
V5.2.0	September 2002	Publication
V5.3.0	December 2002	Publication
V5.4.0	March 2003	Publication
V5.5.0	June 2003	Publication
V5.6.0	September 2003	Publication
V5.7.0	December 2003	Publication
V5.8.0	March 2004	Publication
V5.9.0	June 2004	Publication
V5.10.0	June 2005	Publication

EXHIBIT J

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

Before the Honorable Paul J. Luckern
Administrative Law Judge

In the Matter of **CERTAIN 3G MOBILE HANDSETS AND COMPONENTS THEREOF**	**Investigation No. 337-TA-613**

COMPLAINANT'S FIRST SET OF REQUESTS FOR ADMISSION TO RESPONDENTS NOKIA CORPORATION AND NOKIA INC. (NOS. 1-39)

Pursuant to Commission Rule 210.29, 19 C.F.R. § 210.29, the Ground Rules (Order No. 1) and the Protective Order (Order No. 2), Complainants, InterDigital Communications Corporation and InterDigital Technology Corporation (collectively "InterDigital"), request that Respondents, Nokia Corporation and Nokia Inc. (collectively, "Nokia") answer the following requests for admission, in writing and under oath, within ten (10) days after service.

INSTRUCTIONS AND DEFINITIONS

1. InterDigital hereby incorporates by reference the Definitions and Instructions set forth in InterDigital's First Set of Interrogatories and First Set of Requests for the Production of Documents and Things to Nokia, as if fully set forth herein.

2. The term "ETSI" refers to European Telecommunications Standards Institute.

3. The term "TS" refers to technical specification.

4. The term "N75" refers to the model number of a Nokia cellular handset.

5. The term "3G WCDMA standard" refers to the 3G UMTS Technical Specifications for Release 1999, which were promulgated by ETSI.

6. The term "essential" refers to the definition of "ESSENTIAL" set forth by ETSI in the "ETSI Guide on Intellectual Property Rights (IPRs)," Version endorsed by General Assembly #48 on November 22, 2006, Section 1.5.

7. You are under a duty to continue to supplement all responses to these requests to include information acquired after service of the responses, even if such responses were correct when first provided. 19 C.F.R. § 210.27(c).

REQUESTS FOR ADMISSION

1. The N75 is capable of operating in accordance with the 3G WCDMA standard.

2. The N75 has been certified as capable of operating in accordance with the 3G WCDMA standard.

3. Nokia has stated publicly that the N75 is capable of operating in accordance with the 3G WCDMA standard.

4. The N75 is adapted to operate in accordance with the 3G WCDMA standard.

5. The N75 is designed to operate in accordance with the 3G WCDMA standard.

6. The N75 is capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999.

7. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999.

8. The N75 is capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 4.1.

9. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 4.1.

10. The N75 is capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 5.2.2.1.

11. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 5.2.2.1.

12. The N75 is capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 5.3.3.7.

13. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.211, Version 3.12.0, Release 1999, § 5.3.3.7.

14. The N75 is capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999.

15. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999.

16. The N75 is capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.2.2.

17. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.2.2.

18. The N75 is capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.2.5.

19. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.2.5.

20. The N75 is capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.3.1.

21. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.3.1.

22. The N75 is capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.3.2.

23. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.213, Version 3.9.0, Release 1999, § 4.3.3.2.

24. The N75 is capable of operating in accordance with 3GPP TS 25.214, Version 3.12.0, Release 1999.

25. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.214, Version 3.12.0, Release 1999.

26. The N75 is capable of operating in accordance with 3GPP TS 25.214, Version 3.12.0, Release 1999, § 6.1.

27. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.214, Version 3.12.0, Release 1999, § 6.1.

28. The N75 is capable of operating in accordance with 3GPP TS 25.301, Version 3.11.0, Release 1999.

29. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.301, Version 3.11.0, Release 1999.

30. The N75 is capable of operating in accordance with 3GPP TS 25.301, Version 3.11.0, Release 1999, § 5.2.1.1.

31. The N75 has been certified as capable of operating in accordance with 3GPP TS 25.301, Version 3.11.0, Release 1999, § 5.2.1.1.

32. The '004 patent is essential to the practice of the 3G WCDMA standard.

33. The '004 patent is not essential to the practice of the 3G WCDMA standard.

34. The '996 patent is essential to the practice of the 3G WCDMA standard.

35. The '966 patent is not essential to the practice of the 3G WCDMA standard.

36. Practice of the 3G WCDMA standard infringes the '004 patent.

37. Practice of the 3G WCDMA standard does not infringe the '004 patent.

38. Practice of the 3G WCDMA standard infringes the '966 patent.

39. Practice of the 3G WCDMA standard does not infringe the '966 patent.

Respectfully submitted,

By: Vamsi K Kakarla

Smith Brittingham IV
Patrick J. Coyne
Christopher P. Isaac
Lionel M. Lavenue
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Date: September 11, 2007

Counsel for Complainants
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and InterDigital Technology Corporation

Certain 3G Mobile Handsets and Components Thereof

Inv. No. 337-TA-613

CERTIFICATE OF SERVICE

I, Melissa J. Kaufmann, hereby certify that on September 11, 2007, copies of the foregoing documents were served upon the following parties as indicated:

The Honorable Paul J. Luckern Administrative Law Judge U.S. International Trade Commission 500 E Street, S.W., Room 317 Washington, DC 20436 **(2 Copies)**	☐ Via First Class Mail ☒ Via Hand Delivery ☐ Via Federal Express ☐ Via Facsimile ☐ Via Electronic mail
David Hollander Jr. Office of Unfair Import Investigations U.S. International Trade Commission 500 E Street, S.W., Room 401-D Washington DC 20436 david.hollander@usitc.gov	☐ Via First Class Mail ☒ Via Hand Delivery ☐ Via Federal Express ☐ Via Facsimile ☒ Via Electronic mail
Nokia Corporation Olli-Pekka Kallasvuo Keilalahdentie 2-4 P.O. Box 226 FIN-00045 Espoo Finland	☐ Via First Class Mail ☐ Via Hand Delivery ☒ Via Federal Express ☐ Via Facsimile ☐ Via Electronic mail
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EXHIBIT K

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

NOKIA CORPORATION and NOKIA, INC.,)
)
Plaintiffs,)
) Civil Action
v.) No. 05-16
) (JJF)
INTERDIGITAL COMMUNICATIONS)
CORPORATION and INTERDIGITAL)
TECHNOLOGY CORPORATION,)
)
Defendants.)

Special Master Teleconference taken at the law offices of Connolly Bove Lodge & Hutz, LLP, 1007 North Orange Street, Tenth Floor, Wilmington, Delaware, beginning at 3:00 p.m. on Monday, August 20, 2007, before Kathleen White Palmer, Registered Merit Reporter and Notary Public.

BEFORE: COLLINS J. SEITZ, JR., ESQUIRE
Special Master

APPEARANCES:

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ALSO PRESENT:

ANDREW G. ISZTWAN, ESQUIRE
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MS. HEANEY: Julie Heaney from Morris Nichols and Patrick Flinn is on from Alston & Bird.

SPECIAL MASTER SEITZ: Okay. Welcome. Good afternoon.

And for InterDigital?

MR. HORWITZ: It's Rich Horwitz, and with me is Ron Shulman, Mike Levin, Chris Isaac, and Andy Isztwan from InterDigital.

MR. FLINN: Good afternoon, everyone, and thank you. We are on the record now.

Mr. Flinn or Ms. Heaney, I believe it's your request.

MR. FLINN: This is Patrick Flinn, Mr. Seitz.

Yes, this is our request with respect to two of the 26 patents that were the subject of a submission to ETSI in March of 2007. As I'm sure you recall, these 26 patents were the subject of two requests by Nokia not to have them included in the materials we are presently submitting regarding contentions in discovery.

On those two occasions, at InterDigital's urging, you overruled our objections and said we should go ahead and provide contentions regarding the

essentiality of those 26 patents.

Some days, literally a couple of days after they last asked you to require us to submit contentions on these patents -- and one of the reasons, ironically, they gave you why we should do this was because they were afraid of multiple litigation -- they filed two actions, one in the ITC, and the other one in District Court in Delaware accusing Nokia of infringing those two patents.

With that information, we had asked for relief from your order with respect to those two patents given the fact that we don't know yet where the litigation over these two patents ought to take place: in this case; in the new case they have filed, which, according to my most recent understanding, was assigned to Judge Robinson; or the case that they filed in the ITC.

We think that it is appropriate for contentions regarding these two patents to wait until we find out in which forum they are going to be litigated in the first instance to avoid prejudice as a result of leveraging statements in one patent into another lawsuit, and as a result of the need to move resources in consideration of these patents.

I would note just a couple of things, one of which is, as I'm sure, Mr. Seitz, you are aware, when an action is filed in the ITC, a respondent, the named respondent is entitled to a stay of infringement litigation of those patents in a District Court action while the ITC matter is proceeding.

It is ironic that while they are not entitled to proceed with an infringement litigation that somehow they could get around that by the mechanism that they have used here.

My final comment is simply that there's no prejudice in any meaningful way to InterDigital from the relief that we are requesting. It is not as if we are running out of patents to litigate in the current proceeding that we have in front of us. There is plenty of work to do on all the other patents. And if we set these two patents aside for the time being until the proper forum is sorted out, I think no one will be harmed.

SPECIAL MASTER SEITZ: So, Mr. Flinn, the suit that was recently filed by InterDigital, that is a patent infringement action as opposed to a Lanham Act action? Do I have that correct?

MR. FLINN: That's correct. It is a patent

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infringement action accusing us of infringing these two patents.

SPECIAL MASTER SEITZ: Explain to me again, because I'm not sure I completely understand, how Nokia is prejudiced by having to fulfill its discovery obligations in the Lanham Act case for these two patents.

MR. FLINN: The issue is two-fold. The first is there is statutorily recognized prejudice from having to proceed on the same patents in the District Court and in the ITC.

SPECIAL MASTER SEITZ: But it's a different claim.

MR. FLINN: It is a different claim but the same issues are present. As we have pointed out in the past, our Lanham Act case is not limited merely to the question of whether or not the patents are essential. Our claim arises from the assertion that InterDigital has made publicly that Nokia and others owe it money for the right to use these patents.

SPECIAL MASTER SEITZ: I understand the overlap in issues, Mr. Flinn. Do you have any authority for the proposition that where related issues are raised that the ITC proceeding and the stay

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that might accompany it should apply in a case like this?

MR. FLINN: I don't think that anybody has ever attempted to do what InterDigital has done in this case.

The argument I raise based on the ITC statute is premised on the policy underlying it. I don't think that there is any direct precedent in which the patents were being litigated in a Lanham Act case, and where then someone filed an ITC action at the same time.

But the statute provides for a mandatory stay if requested by the responding party and a discretionary stay to stay other aspects of it, as necessary, and I think that the policy underlying those provisions are applicable here.

But the larger issue is that InterDigital would love to be able to get discovery now on these patents when it's not entitled to that discovery as yet in either of the two proceedings in which those two proceedings and how they are governed and where they will be governed are going to be decided by other judges.

Given the fact that the proper location for

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these three patents has not been decided yet, it will have to be decided. I don't think that there's a reasonable scenario that contemplates the scope and validity of these patents being litigated in this case or in another case at the same time. That makes no sense at all.

If that's going to be the case, we ought to figure out which court they are going to be in so we don't avoid duplication of discovery and we don't avoid the situation in which they are able to take the discovery in this case and leverage it for use in the other proceedings where they are not entitled to discovery.

SPECIAL MASTER SEITZ: Okay.

Mr. Shulman, are you speaking?

MR. SHULMAN: Yes, sir, I am, or will be shortly here. Let me start out where Mr. Flinn left off.

The scope and validity of the patents are not at issue in this case. You have already ruled that infringement, validity, enforceability are not the issues to be discovered in this case, but rather whether or not the patents are essential to the standard.

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The issue of essentiality that's present in the case that we are before you on today is not at issue in the ITC case and is not at issue in the companion District Court case that is pending before Judge Robinson. Essentiality has nothing to do with infringement. Either they infringe or they don't, and that's a particular product that infringes and that product is not at issue in the case that brings us here together today.

With respect to taking positions on essentiality, once again, that has nothing to do with the way that their product operates. We are going to address that in the ITC case and/or the District Court action.

Here they simply look at the standard which is applicably available information, compare the standards of the patent, and take a position one way or the other as to whether or not they believe that the patent is or is not essential.

So there is no direct overlap whatsoever between the issues to be litigated in the ITC and the recently filed District Court action and the issues to be litigated in the present case. In this case there are no contentions about infringement. There are none

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about validity. There are none about enforceability. Those will be the three issues that get litigated in the ITC case and in the District Court action.

So I don't see why there is any reason for them not to take a position. In fact, they've already taken the position when they gave us their contentions on the other 24 patents. That document contained their contentions on these two patents because they perfectly well formulated them. They just masked it out. So the work is done.

Insofar as inconsistent positions are concerned or how we might leverage it, we have a protective order here that allows us to use the information in the manner that is prescribed by the protective order and we intend to abide by that.

So this notion that we are somehow going to improperly take discovery that was obtained in this case and use it contrary to however the protective order allows us to use it is just nonsense.

So I don't see, going back to the original question that you put to Mr. Flinn, what prejudice are they going to suffer, he hasn't articulated any because there is none. They have already formulated their positions. We can go forward. If they want to

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stay the District Court action, which is their option, not our option, they are perfectly free to do so.

With respect to the insinuation both in the letter to you and in today's comments that somehow we were playing games here, had we filed suit in the ITC and in the District Court two days after instead of two days before the contentions were due, we'd have the contentions and there would be no issue about it. The fact that we did it earlier rather than later gave them more information, not less information.

So I don't see any prejudice here. I don't see any reason to derail what has already been argued three times here; namely, they have to respond on these patents and they should be ordered to do so and they can do it in a heartbeat. All they have to do is unmask the portions of the work they've already generated.

SPECIAL MASTER SEITZ: Mr. Flinn?

MR. FLINN: A couple of responses.

Let me be crystal clear about one issue because I think Mr. Shulman and I see this quite differently.

Mr. Shulman says that this case has got nothing to do with the validity of the patents or

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their scope and it says that you have so ruled.

Mr. Seitz, with all due respect, you have made rulings with regard to what may be proper subject of discovery, but I don't think there is or can be any legitimate dispute as to the breadth of the allegations that we have made in our first amended complaint and the issues that are tendered to Judge Farnan for resolution.

Now, whether or not they want to convince Judge Farnan not to consider these issues does not mean that they are not in the case. Whether they are -- whether the validity of the patent is currently a subject of discovery under a discovery management plan that they have asked you to implement, again, does not mean that those issues are not to be adjudicated in this case.

The other thing that Mr. Shulman said that I think is quite important is his suggestion that there is no connection whatsoever between the essentiality of the patents and their infringement.

That is, I don't think, really a sustainable position under much scrutiny at all. Why would anyone claim that they are essential under any definition of essential if it doesn't mean that you're

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contending that if you comply with the standard that that somehow is connected to your infringement of the patents?

If we need any more evidence that there is at least some relationship between infringement and essentiality, you can look to the claims charts that InterDigital submitted to the ITC.

If essentiality were completely unrelated to the question of infringement, InterDigital would have said nothing about the standards in its submission to the ITC, but no. In its claims charts it specifically attempted to read the patents onto the standard.

Indeed, if you read their complaint carefully, one of the things that they are trying to get out of the ITC is a ruling not just that Nokia's products currently manufactured in compliance with the standard infringe, but they are going to seek a ruling, and certainly they are complained to use of this, that all standards-compliant products infringe and, thus, joining the issue of essentiality and infringement very closely, which explains the leverage that they are trying to get out of using this proceeding to get discovery that they are not

Page 14

necessarily entitled to in the ITC or in their District Court action.

It is not the work involved. It is the prejudice of having to litigate on two or three fronts at the same time that is the prejudice here. It is, again, I think without reasonable doubt that the scope of the patents and their validity is raised in all three proceedings.

SPECIAL MASTER SEITZ: Mr. Shulman, when you talked about the protective order, does it have one of those provisions in it that talks about the evidence only being used for purposes of this particular proceeding?

MR. SHULMAN: I don't have it before me, so I can't say unequivocally that the answer is yes, but I believe it does. Maybe somebody else on the line can respond to that.

SPECIAL MASTER SEITZ: Well, or maybe you can just make a commitment or a representation.

Is what you are offering is to only use the information for purposes of this proceeding? I mean, the typical protective order language is such that you can only use it for purposes of the pending proceeding.

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So obviously relief can be sought from that, but as I interpreted those provisions in the past, it basically means that what happens in one case can't be used in another case absent an amendment of a protective order by the Court.

MR. SHULMAN: I am not actually representing InterDigital in the ITC matter, but counsel on the line is, and so I will defer to them on that. But I believe that the protective order has that provision and, you know, we can certainly double-check, but certainly that was my intention.

SPECIAL MASTER SEITZ: That's why I'm just trying to circle back to why you raised the protective order issue in the first place.

MR. SHULMAN: Yes, because I believe that it has this provision in it that says thou shalt only use stuff in this case and this case only because they typically all do, and so this notion that we are somehow gaining an unfair advantage wouldn't make any sense.

If the protective order doesn't have that provision, that may be a different story, but I believe that it doesn't. I don't know. Maybe somebody is looking it up while we are speaking on

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this matter.

SPECIAL MASTER SEITZ: Okay.

MR. FLINN: Let me respond to the protective order very briefly because I don't think that it cures any of the problems.

First of all, it doesn't cure the problem that we should not be forced to litigate these same patents on the same issues on multiple be fronts.

Secondly, there is no guarantee that either Judge Robinson or the ITC would find this protective order to be any particular barrier. All it takes is an order requiring Nokia to produce to them what we've said in this case, and there is nothing we can do about that. We would be required to comply with that order or face the sanctions that could be imposed by either Judge Robinson or the ITC.

Secondly, this is a bell that cannot be unrung. Once InterDigital uses this lawsuit to leverage information out of this, they can't forget the information and the same counsel who are here on the pleadings on this case and with entitlement to access to it can have and will have access to it and they can't forget it and put it out of their minds when they are in front of the ITC.

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The issue is that at some point, some group of people between Judge Farnan, Judge Robinson, and the ITC are going to figure out where these patents belong. Until that happens, there is no reason to proceed with forcing Nokia to produce discovery on these patents or, frankly, InterDigital from doing discovery on these patents until that issue is sorted out.

MR. SHULMAN: There's not going to be a meeting of three judges. It never happens in the history of jurisprudence as far as I know. I mean, cases proceed on the basis that they proceed. We are allowed to bring an action in the ITC and a companion case in the District Court.

The fact that they chose to pick a fight with us earlier that happens to overlap in some sense is not our problem. We are allowed to proceed in a manner we want to proceed.

They can stay the District Court action if they choose to. It's their right to do that. We don't have the right to do that. They have the right to do that.

Then they will be proceeding with respect to particular accused products in the ITC on the issue

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of infringement, and we will proceed in this case on the Lanham Act claims which have nothing to do with infringement because there's no product at issue here. It's strictly a comparison between what the standard says and what the patent claims look like.

MR. FLINN: Again, Mr. Shulman's narrow view of our complaint simply can't be reconciled with the plain allegations in it.

But more to the point, it is not a given in my mind that the ITC action is going to be the one that proceeds. Maybe it will. It's not a given in my mind that the action in front of Judge Robinson won't proceed. It may be that it does.

But the point is you have all three of them in this case, and there is no compelling reason why out of the nearly 300 or more patents that are at issue in this case, for some reason there is a burning, pressing need to get discovery on these two patents.

In fact, the fact that InterDigital is so hot and insistent on all the patents getting discovery on these two suggest that there is some reason why they need to get our contentions on these patents forthwith.

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SPECIAL MASTER SEITZ: But, Mr. Flinn, as Mr. Shulman said, what if they waited a week and then filed a suit? Would you be making the same arguments? I mean, with all due respect, I have to say it's somewhat of a "So what?" If they had waited a week, this wouldn't have even mattered; right?

MR. FLINN: I don't know what their timing was. I don't know if it was entirely voluntary on their part because I don't know what the ITC made them do when they did it.

So it's not entirely clear to me that they were doing us a big favor by doing this earlier. It may well be that they intended to spring a trap and they just weren't able to.

But even if they weren't compelled to make this disclosure earlier than they wanted to, had they, in fact, attempted to do this, the relief we would have sought in that instance might well have been much more significant with respect to preserving our rights here, including whether or not the counsel who attempted to close the track should be able to participate in the other litigations where they would not be entitled to have this information.

It may well have been that counsel's

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calculation about risks and benefits springing the trap were such that they elected to not risk springing the trap because they didn't want to risk being disqualified by this maneuver, particularly when they knew this was all going to happen when they were asking you to make us provide this discovery.

They are faced with a protective order that said they are not supposed to be used in other cases, and that may well have been part of their calculation.

MR. SHULMAN: Special Master Seitz, this is Rich Horwitz. I want to complete the record on the protective order.

I'm not going to get into the discussions about whether there was a trap or not. I think that you asked the right question and I'm not sure if it was even answered.

But paragraph 20 of the protective order says: "Subject to paragraph 2 above, confidential and attorneys'-eyes-only information shall be held in confidence by each person to whom it is disclosed, shall be used only for purposes of this litigation, should not be used for any other purpose, suit, arbitration, or legal proceeding, and shall not be disclosed to any person who is not entitled to receive

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such information as herein provided.

"All produced confidential and attorneys'-eyes-only information shall be carefully maintained so as to preclude access by persons who are not entitled to receive such information."

SPECIAL MASTER SEITZ: And the "subject to" language in 2(a), does that change that result at all?

MR. LAWSON: Your Honor, this is Mr. Lawson for Nokia.

It does. The first sentence of paragraph 2 of the protective order says: "By entering the order and limiting disclosure of information in this case, the Court does not intend to preclude another court from finding that the information may be relevant and subject to disclosure in another case."

MR. SHULMAN: Ron Shulman.

Of course, that's always true. If one Court orders you to do something, you got to do it. But the point is: You can't voluntarily make use of it.

SPECIAL MASTER SEITZ: Okay. Your arguments have been helpful. Here's my ruling.

It's my view that there are different claims pending in the case that has been proceeding

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here in the District of Delaware; namely, Lanham Act claims versus the patent infringement claims which have been brought by InterDigital against Nokia on the two patents and are also the subject of ITC proceedings.

Although the issues may overlap to some degree, the claims are different and this litigation has been proceeding apace for some time under the understanding that we are going to get discovery completed in a timely fashion for all patents that so far have been made part of these proceedings and, therefore, in my opinion, it does not warrant excluding these two patents even though they were part of the March 2007 submissions.

Again, I want to emphasize, this case has been pending for some time and has been moving apace, and I don't want to see discovery bifurcated for two of the patents while the litigation proceeds towards the close of discovery and to trial.

There has been mention, although I'm not relying on it exclusively, of the protective order provision which deals with using the information only for purposes of this litigation.

Now that we have had this telephone

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conference and I am making my ruling in this case, obviously there's a heightened concern about sharing information, and I would think that Nokia could bring this to the attention of the District Court when and if appropriate if there is an application made to deviate from the language of the protective order.

Finally, I find that there really is no real prejudice to Nokia in providing the information on two patents out of a number of patents. We are in discovery as opposed to another phase of the litigation as Mr. Flinn pointed out.

So although, as he said, there might be prejudice in, quote, litigating the patents, the view I have right now is that we are only in discovery. The issues relate primarily, although not exclusively, to the essentiality determinations. Therefore, Nokia will not be prejudiced providing this information on the two patents.

So it's my ruling and recommendation that the information be provided. This transcript will act as the formal order entered by me, so if there are exceptions taken from it, follow the local rules for taking exceptions.

Is there anything else I can help you with

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today?

MR. FLINN: This is Patrick Flinn, Mr. Seitz.

In discussions with my client about seeking review by Judge Farnan from this order, and to the extent necessary, we would be asking Judge Farnan to stay this aspect of the order until he can review it.

In many instances, and this is probably one of them, that application has to be first made to you before we can make it to Judge Farnan.

So what I would ask is if you would agree to stay the application of this order pending our appeal of it to Judge Farnan.

SPECIAL MASTER SEITZ: I will. The order is stayed pending your opportunity to have my recommendation reviewed by Judge Farnan.

Do you want to fix a date by when you'll decide so that we can get this closed off, Mr. Flinn?

MR. FLINN: We will certainly decide whether to take the appeal by this Friday.

SPECIAL MASTER SEITZ: Okay. Let's set Friday as the deadline for filing any exceptions to this ruling.

I was curious, also, to see that the case

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was assigned to Judge Robinson, the InterDigital new case. Did counsel for InterDigital put on the civil cover sheet that this was a related proceeding to the pending proceeding or not?

MR. SHULMAN: Yes. Notice of related case was actually filed by Nokia, I believe, and we joined in. But, you know, the inner workings of the court, who knows what happened?

SPECIAL MASTER SEITZ: Okay. Just very curious.

MR. SHULMAN: There is one other issue we wanted to raise with you if you have just another minute or two.

SPECIAL MASTER SEITZ: Yes.

MR. SHULMAN: We were just wondering, Judge Farnan hasn't entered or signed that other scheduling order.

SPECIAL MASTER SEITZ: Yes.

MR. SHULMAN: I don't know if there's an issue that he needs us to address or what the status is, but we wanted to inquire to see if perhaps you knew if there was something else we needed to do to move that along.

SPECIAL MASTER SEITZ: I'll inquire of the

Court and see if there are any issues. Okay?

MR. SHULMAN: Okay.

SPECIAL MASTER SEITZ: Mr. Flinn, anything else?

MR. FLINN: No. That is it from our side.

SPECIAL MASTER SEITZ: Okay.

Mr. Shulman?

MR. SHULMAN: No. That's it. Thank you.

SPECIAL MASTER SEITZ: Okay. Thank you very much.

ALL: Thank you.

(The hearing was then concluded at 3:30 p.m.)

State of Delaware)
)
County of New Castle)

CERTIFICATE

I, Kathleen White Palmer, Registered Professional Reporter and Notary Public, do hereby certify that the foregoing record, pages 1 to 27, inclusive, is a true and accurate transcript of my stenographic notes taken on Monday, August 20, 2007, in the above-captioned matter.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 20th day of August, 2007, in New Castle County.

KATHLEEN WHITE PALMER, RMR, CSR, CLR
Certification No. 149-RPR
(Expires January 31, 2008)

EXHIBIT L

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September 11, 2007

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Re: ***Nokia Corporation, et al. v. InterDigital Communications***
C.A. No. 05-016 - JJF

Dear Counsel:

Pursuant to the First Amended Case Management Order, the following patents have been designated by the parties as Representative Patents:

I. InterDigital's Selection of Representative Patents.

A. InterDigital Representative Patents:

1. U.S. Patent No. 5,574,747
2. U.S. Patent No. 6,674,791
3. U.S. Patent No. 6,717,927
4. U.S. Patent No. 6,873,643
5. U.S. Patent No. 6,956,889
6. U.S. Patent No. 6,973,579
7. U.S. Patent No. 6,993,063
8. U.S. Reissued Patent No. RE38,627

B. Nokia Representative Patents:

1. U.S. Patent No. 5,479,444
2. U.S. Patent No. 5,850,607
3. U.S. Patent No. 6,011,971
4. U.S. Patent No, 6,094,426
5. U.S. Patent No. 6,415,163
6. U.S. Patent No. 6,717,928
7. U.S. Patent No. 6,742,091
8. U.S. Patent No. 6,792,278

II. Nokia's Selection of Representative Patents.

A. InterDigital Representative Patents

1. U.S. Patent No. 6,915,473
2. U.S. Patent No. 6,973,579
3. U.S. Patent No. 6,845,104
4. U.S. Patent No. 7,085,583
5. U.S. Patent No. 6,801,516
6. U.S. Patent No. 6,798,759
7. U.S. Patent No. 5,574,747
8. U.S. Patent No. 6,330,272

B. Nokia Representative Patents

1. U.S. Patent No. 6,987,779
2. U.S. Patent No. 6,826,406
3. U.S. Patent No. 7,106,694
4. U.S. Patent No. 6,842,445
5. U.S. Patent No. 7,193,990
6. U.S. Patent No. 6,871,075
7. U.S. Patent No. 6,859,651
8. U.S. Patent No. 6,574,473

Yours very truly,

Collins J. Seitz, Jr.

CJS,Jr./saj
(563352)

EXHIBIT M

REDACTED